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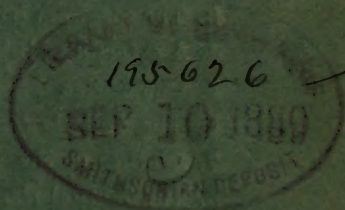
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ON

E. F. Atkinson

INDIAN INSECT PESTS.



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NOTICE.

THE serial *Indian Museum Notes*, issued by the Trustees of the Indian Museum, Calcutta, under the authority of the Government of India, Revenue and Agricultural Department, is to take the place of *Notes on Economic Entomology*, of which two numbers have appeared.

The parts of the serial will be published from time to time as materials accumulate. Communications are invited; they should be addressed to—

The Editor,
Indian Museum Notes,
Calcutta.

Correspondence connected with Economic Entomology should be accompanied by specimens of the insects to which reference is made. Caterpillars, grubs, and other soft-bodied insects can be sent in alcohol; chrysalids and cocoons, alive, and packed lightly in leaves or grass; other insects, dried and pinned or wrapped in soft paper. Live insects should be sent when there is a reasonable probability of their surviving the journey. Caterpillars, grubs, and other immature insects can often be only approximately determined; they should therefore, where possible, be accompanied by specimens of the mature insects into which they transform; when, however, this is not possible, they should still be sent, as they can always be determined approximately, and uncertainty must necessarily arise in discussing insects when actual reference to the specimens cannot be made.

The papers in the first number of *Indian Museum Notes* deal with Indian insect pests, and are based on material which has been sent to the Museum by the Revenue and Agricultural Department of the Government of India, by the Departments of Agriculture attached to the various Local Governments, by the Forest Department, and also by many private individuals in different parts of India. For the views expressed the authors of the respective *notes* are alone responsible.

THE EDITOR.

INDIAN MUSEUM,
April 1889.

NOTES ON INDIAN INSECT PESTS.

RHYNCHOTA.

BY

E. T. ATKINSON, B.A., C.S., C.I.E.

THE RICE SAPPER (*Leptocorisa acuta*).*Plate I, fig. 1 ; a, enlarged ; b, natural size.*

IN 1886, some specimens of an insect, belonging to the order Rhynchota and section Heteroptera, were received from Mr. J. Lee-Warner, of Tinnevely, and were found to have considerably injured the autumn rice. They were identified with *Leptocorisa acuta*, Thunb., a wide-spreading species found all over the East on rice. In the North-Western Provinces (Gorakhpur), Chota-Nagpur and Assam, this insect is known as *gandhi*, and in Assam attacks especially the *ahu* rice. In Tinnevely it is called the *munju vandu*, or rice-juice sucker or sapper. There is every reason to believe that the numerous references which are given below all belong to one and the same species or its local varieties. This species is represented in South America by the closely allied *Leptocorisa filiformis*, Fabr.; in Central and North America, by *L. tipuloides*, De Geer; in Africa by *L. apicalis*, Westw.; and in Australia by *Mutusca brevicornis*, Dallas. The general colour of the Indian species varies from virescent (which in old specimens fades to sordid yellow) to testaceous, and even brownish-testaceous: the rings, at the base of the 2-4 joints of the antennæ, vary in the space occupied by them, and, in colour, from white to fulvous and testaceous, and are sometimes very faint; the first joint of the antennæ is sometimes entirely testaceous: abdomen above reddish orange, beneath entirely flavescent or with a row of four brown spots on each side. Those without spots beneath are smaller, and, in the Indian Museum collection, are from Assam and Sikkim; the spotted forms are from Calcutta, Behar, Tinnevely and Ceylon, but in some of these latter specimens the spots are so nearly obsolete as to be barely traceable.

Mr. D. J. Macpherson, C.S., of Bankura, writes that this insect appeared in the sudder sub-division of his district, where it is called *bhoma*, and damaged the early rice crop when ripening (September). In the Proceedings of the Agri-Horticultural Society (18th May 1871) it is

noticed that seedlings from some experimental sowings of Carolina paddy were attacked by the *gandhi*, whilst the indigenous seedlings escaped. The pest was also reported from Partabgarh in Oudh, and is there described as greenish-brown, having an offensive smell: it settles on the rice when milky and sucks out the juice, leaving the husk dry: as many as six to ten of these insects have been seen on a single ear. The Deputy Commissioner of Hazaribagh also reports the rice-bug (*Gandhi makkhi*) as attacking the *gora* and *badhi* rice while in the ear: it destroys up to three-fourths of the crop and generally appears in a year when the rain sets in early (May). The insect in the larval state is most destructive, sucking out the juices from the halm, which withers and turns yellow, but we know nothing of its life-history, how many broods there are; where the eggs are laid and apparently hibernate; whether any attempts at destroying the pest have been made and with what result. Smoking the fields attacked by burning vegetable refuse to windward might be tried, but the area is too large for the ordinary methods of insecticide preparations.

Leptocorisa acuta, Thunberg.

Cimex acutus, Thunberg, Nov. Ins. Spec. ii, p. 34 (1783), Atkinson, Proc. As. Soc. Beng. Jan. 1887. China.

Var. *a*.—*Cimex angustatus*, Fabr., Mant. Ins. ii, p. 308 (1787).

Cimex angustus, Gmelin, ed., Syst. Nat. i (4), p. 2193 (1788).

Gerris oratorius, Fabr., Ent. Syst. iv, p. 191 (1794); Syst. Rhyng., p. 261 (1803). India.

Gerris angustatus, Fabr., Ent. Syst. iv, p. 191 (1794); Syst. Rhyng., p. 262 (1803); Stål, Hem. Fabr. i, p. 66 (1868); Ofv. K. V.-A., Förh., p. 658 (1870). China, Philippines.

Myodochus trinotatus, Herr. Schäff., Wanz. Ins. viii, p. 95, t. 281, f. 863 (1848). Java.

Leptocorisa angustata, Walker, Cat. Het. iv, p. 173 (1871). India, China, Australia.

Leptocorisa (*Rhabdocoris*) *acuta*, Stål, En. Hem. iii, p. 86 (1873), China, Java, Australia.

Gerris varicornis, Fabr., Syst. Rhyng., 260 (1803); Wolff, Ic. Cim. v, p. 202, t. 20, f. 196 (1811); Stål, Hem. Fabr. i, p. 67 (1868) excl. syn. *G. apicalis*; Ofv., K. V.-A., Förh., p. 658 (1870). Tranquebar, Philippines.

Leptocorisa flavida, Guérin, Voy. La Coquille, Zool. ii, p. 178, t. 12, f. 12 (1830).

Coreus (*Stenocephalus*) *varicornis*, Burm., Nov. Act. Ac. Leop., xvi., Sup., p. 298 (1834).

Myodochus varicornis, Burm. Handb. Ent. ii (i), p. 325 (1835). Sumatra, Philippines.

Leptocorisa chinensis, Dallas, List Hem. ii, p. 483 (1852); Walker, Cat. Het. iv, p. 172 (1871). China.

Var. *b*.—*Leptocorisa bengalensis*, Westw., Hope Cat. Hem. ii, p. 18 (1842); Stål, En. Hem. iii, p. 87 (1873). Bengal.

Leptocorisa maculiventris, Dallas, l. c., p. 484 (1852); Walker, l. c., p. 172 (1871)—(?)

Leptocorisa varicornis, Dallas, l. c., p. 484 (1852); Walker, l. c., p. 172 (1871); Stål, En. Hem. iii, p. 86 (1873); Distant, A. M. N. H. (5) iii, p. 127 (1879). Assam.

Var. *a*.—Above greyish, beneath entirely flavescent: antennæ and feet somewhat testaceous (*G. angustatus*, Fabr.). Virescent; antennæ obscurely flavescent, last joint white at base: beneath flavescent, immaculate: abdomen above rufous (*G. oratorius*, Fabr.) Sordid greenish-yellow: 2-4 joints of antennæ yellow at base, black at apex (*M. binotatus*, Herr. Schöff.). Long, 18 mill. Testaceous; thorax greenish, with the lateral margins whitish: membrane with a black spot on the inner basal angle: abdomen beneath yellowish-white: antennæ with basal joint fulvous, black externally and at apex: 2-3 joints black, fulvous at base; last joint brown, fulvous at base (*L. chinensis*, Dallas). Long. 16-17 mill. Body linear, above flavescent, margin of thorax and hemelytra whitish: antennæ elongate, filiform, 5-jointed (?), first joint very short, globose, rest cylindrical, equal, inserted between the eyes, as long as the body, joints flavescent at base, black at apex: rostrum porrect, longer than head, inflexed, inserted below the clypeus; sheath 4-jointed, the joints subequal, last a little shorter, somewhat obtuse: labium porrect, elongate, very fine, corneous, subulate, as long as the first joint of the sheath; setæ three, equal, subulate, as long as the sheath: wings hyaline with a small common fuscous spot at the base: beneath flavescent (*G. varicornis*, Fabr.).

Var. *b*.—Above fulvous testaceous: membrane with a brown curved streak on the inner margin, within the basal angle: abdomen above reddish-orange, beneath with a row of four brown spots on each side (*L. maculiventris*, Dallas). Long. 17 mill. Virescent-luteous: antennæ brunneous-fulvous, 2-4 joints paler at the base: a thin arcuate fulvous line at the base of the membrane: median segments of the abdomen furnished beneath on both sides with a fuscous spot: feet fulvous (*L. bengalensis*, Westw.). Long. 16½ mill.

The Indian Museum possesses specimens from Ceylon, S. India, Tinnevely, Bombay, Karachi, Behar, Sikkim, Calcutta, Assam.

CHORA-POKA.

A bottle containing specimens labelled *Chora-poka*, received from Mr. R. Cornish, C.S., of Balasore, contained the larvæ of several species of Rhynchota belonging to different families. The local report states that

when the sesamum crop is gathered and stacked on the threshing-floor, the insects appear in vast numbers and eat out the kernel of the seed, leaving only the husk. To prevent the attacks of the insect, the stalks are steeped in water for a day, and thus induce a partial decomposition which produces a bad smell that appears to be distasteful to the insects and checks their progress. Amongst the insects found in the bottle are the small pentatomid, *Carbula biguttata*, Fabr.,—a species belonging to the family Lygæidæ,—and the larvæ of several species in too early a stage for identification. It is not considered probable that any of these insects are concerned in eating out the interior of the sesamum seeds.

THE GREEN BUG. (*Nezara viridula*, Linn.).

Atkinson, Jl. As. Soc. Ben., Pt. II, p. 119 (1888).

This cosmopolitan insect, found almost in every country in the world, has been reported as occurring on potato halms in Bangalore (Mr. J. Cameron).

CAPSIDÆ.

Mr. Atkinson has under preparation a monograph of the genus *Helopeltis*, Sign., to be illustrated with figures of all the described species of this genus. It is well known to all interested in the tea industry as the 'mosquito-blight;' and would seem to be of great economical interest, both in Assam and all other tea-growing countries.

Disphinctus humeralis, Walker.

Monalonion id, Walker, Cat. Lep. Het. vi, p. 162 (1873).

This is another pest belonging to the family Capsidæ, which has been recently discovered attacking the cinchona at Mungphu in Sikkim. It does not, however, seem to have done much damage, and has for some time disappeared.

Walker's description is as follows :—

"Red, slender, shining, very finely punctured: head short, triangular, eyes black, prominent: rostrum reaching the intermediate coxæ; antennæ black, very slender; first joint piceous, rather stout, a little shorter than the head; second joint more than thrice as long as the first; pronotum contracted in front, with two transverse furrows, and with a large black spot on each side posteriorly: legs luteous, slender corium and membrane hyaline, brownish cinereous; veins brown."

Long., $8\frac{1}{3}$ mill. Reported from Malacca.

JASSIDÆ.

Certain species of the Homopterous section of the Rhynchota found attacking the mango were brought to notice in a letter from Mr. W. Gollan, of the Botanical Gardens, at Saháranpur. Mr. Gollan wrote—

"I should like to try 'Buhach' on the mango-bug. By this I do not mean the pest so common in Bengal which attacks the ripe or ripening fruit, but another which

appears to subsist upon the juices of the flowers, young leaves, and young shoots of the mango. I dare say you know the insect I mean. It is a small, dark-coloured wedge-shaped insect, provided with wings, but it cannot fly far, as, when disturbed, it flies about among the leaves for a few seconds and immediately settles upon them again. They are found upon the mango all summer, but do most harm, when the trees are in flower by damaging the reproductive organs, and thus causing interference with the setting of the fruit. I have tried mixtures of soap, tobacco, sulphur, kerosine diluted with milk, &c., upon them, but without noticeable effect. We have not had many of them this year, but there are a few upon some of the trees and quite sufficient of them to experiment with. Last year, and the year before, we had them in myriads, and both these seasons we had light crops of fruit, but this year a fine crop has set, and this I attribute to the comparative absence of these insects. I once sent it to the Agri-Horticultural Society to be named. Mr. Blechynden, the Deputy Secretary of the Society, sent it on to a Mr. F. Moore, of Penge, and he pronounced it to be a cicadid belonging to the genus *Jassus*, but he did not seem to be able to give a more definite name for it. If you have not examined this insect I shall send you some in spirit."

To this letter the following reply was given by the assistant in charge of the Entomological section of the Museum:—

"Mr. Blechynden, of the Agri-Horticultural Society, some time since made over to me some of your specimens of the mango cicadid, which you say injures the reproductive organs of the flowers. I am interested to hear of the failure of soap, tobacco, sulphur, and kerosine and the milk mixtures on it.

"With regard to the Buhach, I am not aware of any place where it can at present be obtained in India, but I applied to the Buhach Company in California about six weeks ago with reference to its introduction, and if any of the insecticide is sent to me in time to be of service, I will at once forward some to you.

"I feel, however, very doubtful myself as to whether the Buhach would be of much use against this bug: it seems to be generally useful against soft-bodied insects, such as caterpillars, only.

"Kerosine and soap solution or milk seems to be the most promising application. You say 'kerosine diluted with milk' was a failure; I wonder if the mixture was churned into a kind of butter before it was diluted with water and sprayed on to the trees; otherwise some parts of the trees would be pretty certain to get sprayed with pure milk and water and a very small area with pure kerosine. It is worth noticing that a stronger wash is often effective when a weaker one fails, and kerosine and soap solution seems to be generally more effective than kerosine and milk."

The insects were sent by Mr. Atkinson to M. Lethierry, of Lille, who pronounced them to be new to science and has named the three species discovered *Idiocerus clypealis*, *niveosparsus*, and *atkinsoni*, respectively. The descriptions will appear in the Journal, Asiatic Society, and in a future number of these notes. In the meantime, it is desirable that steps should be taken during the ensuing season to investigate their life-history more thoroughly. Mr. E. Cotes suggests that a further trial should be given to kerosine emulsion, which should be thoroughly churned and applied in a very fine spray, as suggested for scale insects (p. 7); and also that an attempt should be made to ascertain where the insect lays its eggs and what becomes of it during the greater part of the year when the mango trees are not in flower.

APHIDÆ.

Cerataphis, sp.*Plate I, fig. 2, enlarged.*

In August 1888, some leaves of cinchona infested by a new aphid were sent to Mr. G. B. Buckton, who reports as follows:—

“Although the specimens are in bad condition, partly caused by the spirit being so strong that the contents of the insect are dissolved out of them, they prove to be very interesting, inasmuch as they probably belong to the genus *Cerataphis*, Lichtenstein, described by Mr. Buckton (British Aphides IV, 198, Royal Society). The disc of white-wax is characteristic of this coccus-like aphid. Only one species of this genus has yet been described, and this (*Cerataphis lataniae*, Licht.) has been found to infest the palm, orchis, calamus and other tropical plants in conservatories in Europe. I believe that but three specimens of the winged form have been identified in Europe. Before I can give an opinion as to the species on the cinchona, I should like to have more examples preserved in, say, a 10 per cent. solution of alcohol, or even weaker than this. Single leaves, folded in single pieces of tissue paper and packed separately between layers of cotton-wool, a little tightly pressed in a small box would be sufficient. I have seen some very minute insects thus sent from Mexico.”

The figures show the larva and pupa, the latter enclosed in its sheath. The larva seems to be almost blind, whilst the winged insect is well provided with eyes. Mr. J. Gammie of the cinchona plantation at Mungphu in Sikkim has kindly promised to send Mr. Buckton fresh specimens when the season for them comes round, which will be about April.

PEMPHIGUS CINCHONA, Buckton in litt.

This aphid, together with the larva of a coccinella, was forwarded to Mr. Buckton, who named it provisionally *Pemphigus cinchonæ*. Further specimens are awaited before it can be formally described.

COCCIDÆ.

Mr. Atkinson has recently described a new genus and species of coccid (*Pseudopulvinaria sikkimensis*) found on the cinchona in Sikkim. It appears in the cold-weather in the form of a flour-like substance on the underside of the leaves of oak, chestnut and cinchona, and matures about April. It has not yet spread enough to do any considerable damage.

Dactylopius adonidum, Linn., already described in the Journal of the Asiatic Society (Part II, p. 288, 1886) has been procured from Mysore, where it occurs on *Cedrela* sp., *Acrocarpus fraxinifolius*, *Ficus mysorensis*, *F. glomerata*, *F. asperrima*, &c., and does considerable damage to the coffee bushes. Mr. Anderson, of Barguai (Mysore), has sent some remarkable examples of the curious black fungoid growth which seems invariably to accompany this insect, and, covering the twigs, effectually rots and kills them. He describes it as a black, felted substance, extremely like a fungoid growth: in appearance it is very like the sooty

accumulation that occurs on bottles in cellars and which wine-merchants sometimes exhibit *in situ* on bottles, as evidence of the time that they have been kept. That which accompanies the *Lecanium nigrum*, Nietner, in Ceylon, has been named *Trisporium gardneri* by Berkeley, and is described as having at first the appearance of a thin, diluted black-wash, but, rapidly increasing in density, within two or three months it quite covers and blackens the leaves and other parts of the trees, finally almost resembling moss. Its period of growth, in Ceylon, appears to extend over about twelve months, when it is replaced by a young growth, or both it and the scale abandon the tree, and, when leaving the tree, the fungus peels off in large flakes. Mr. Nietner writes—

‘As the occupation of a coffee or any other tree (by scale-insects) gives rise to the appearance of a glutinous saccharine substance (honey-dew, which is either a secretion of the scale, or its extravasated sap that flows from the wounded tree, or, more probably, a combination of both), which disappears with the scale, and as the fungus does exactly the same, I have no doubt that its vegetation depends upon the glutinous saccharine substance.’

Mr. Anderson also noticed the occurrence of this honey-dew in connection with *Dactylopius adonidum* in Mysore, and writes that the tree, when attacked, bleeds or gums so profusely that the ground all round the stem is made moist.

Mr. Maskell, in his account of the scale-insects of New Zealand, (p. 15), also calls this transparent, gelatinous, fluid excretion, ‘honey-dew,’ and remarks that it is apparently analogous to that exuding from the Aphides, Psyllidæ and Aleurodidæ. It varies in quantity with the species present, and appears to be excreted by a cylindrical tube, exerted from the ano-genital orifice after the manner of a telescope, the furthest-extended portion of the tube, being the most slender. In the genus *Cœlostoma*, when this tube is pushed out to its full extent, there appears at its furthest extremity a minute globule of yellowish, nearly transparent, glutinous fluid, which rapidly expands like a soap-bubble, and, then, suddenly breaking off, falls in spray on the leaf beneath, as the coccids are usually attached to the underside of a leaf. It therefore injures the leaf in two ways, by stopping up the stomata of the leaf itself, and by forming a nidus for fungoid growths which rapidly accumulate and kill those portions of the plant on which they appear. Removing the fungus is not sufficient, but, in addition, the scale-insect itself must be sought out and destroyed by the kerosine emulsion described in No. 2 of these Notes and which for reference is reproduced here—

“An emulsion resembling butter can be produced in a few minutes by churning with a force-pump two parts of kerosine and one part of sour-milk, or soap solution in a pail; emulsions, made with soap solutions being generally found to be the more effective. The liquids should be at about blood-heat. This emulsion may be diluted with from nine to fifty parts of water, which should be thoroughly mixed with one part of the emulsion.

“The strength of the dilution must vary according to the nature of the insect to be dealt with, as well as to the nature of the plant; but finely sprayed in twelve parts

of the water to one of the emulsion, it will kill most insects without injury to the plant."

It should be applied through a spray nozzle (see pl. 4, fig. 4)—

"The nozzle which best combines the necessary qualities is undoubtedly the eddy or cyclone nozzle, consisting of a small circular chamber with two flat sides, one of them screwed on, so as to be readily removed. Its principal feature consists in the inlet, through which the liquid is forced, being bored tangentially through its wall, so as to cause a rapid whirling or centrifugal motion of the liquid, which issues in a funnel-shaped spray through the central outlet in the adjustable cap. The breadth or height, fineness or coarseness, of the spray, depends on certain details in the proportions of the parts, and specially in the central outlet.

"To drive the liquid through the nozzle some kind of force-pump is required, and a great number have at different times been experimented with, some of them being of a most complicated nature. It is perhaps not of any very great consequence which particular form is adopted for use in India; but the aquapult force-pump, which has been arranged to be worked entirely by one man, who also distributes the spray, seems to be about the best suited for general use in a country where economy in labour is generally not so great an object as economy in the cost of apparatus."

LECANIUM ACUMINATUM, Sign.

Ann. Soc. Ent. France, p. 397, t. 12, f. 1 (1873).

Plate I, fig. 3, c, shows the ventral surface (after Signoret); fig. 3 a, the dorsal surface, and fig. 3 b, a side view, the two latter magnified about 7 times.

This coccid was reported by Signoret as occurring on orchids in the conservatories of the Luxembourg. It has since been found on the mango in Ceylon by Mr. E. E. Green, and has been identified by Mr. Douglas with the species described by Signoret. Only the adult form has been found, which is thus described—

Body briefly oval, acuminate towards the apex, rounded, very broad towards the extremity: antennæ 7-jointed, fourth longest, third equal to the fifth and sixth taken together, which are the shortest, the seventh as long as the fifth and sixth taken together. Feet broad, flattened; tarsi short, hardly half the length of the tibiæ. Differs from *L. hesperidum* in the form of the body and the shortness of the tarsi: the embryo, too, is oval, rounded, and very broad where the abdomen commences. Long., 2-3 millimetres.

This coccid is reported by Mr. Green to do some damage to the mang leaves which wither and fall off when attacked.

RHOPALOCERA.

BY

L. DE NICÉVILLE, F.E.S., C.M.Z.S.

A BUTTERFLY INJURIOUS TO RICE (*Suastus gremius*, Fabricius).

Plate I, fig. 4, male imago; 4, b, full-fed larva; 4, c, front and side views of two different pupæ—all from Calcutta specimens and natural size.

A SINGLE report has been received regarding this pest, drawn up by Hafizar Rahaman Ahmed, Tehsildar of the Government Estate, Noanand, in the Balasore District, Bengal, forwarded by the Collector of the Balasore District through the Director of Land Records and Agriculture, Bengal, to the Indian Museum, Calcutta. Accompanying the report seven full-fed larvæ and one pupa of the pest were sent, together with some young paddy leaves on which the larvæ had been feeding. The Tehsildar reports that the pest is known by the local name of "Pattanai," that the larva is about an inch in length, light green in colour, with a deep green line extending down the middle of the back from one extremity to the other. He notes that when they are exposed to the sun they hide themselves [presumably in the shelter, which all larvæ of the family to which it belongs invariably construct for themselves of the leaves on which they live], but when exposed to the rain their movements on the leaves are active. He says also that they eat paddy alone, but this is not correct. He also says that they are attracted at night by the light of a lantern. If this is correct, it is an interesting fact, and one, as far as I know, not before noted with regard to any Lepidopterous larva. He further notes that they build nests [*i.e.* shelters], that they owe their origin to the dirty water, and to the reeds grown on the fields, also that no proper remedy has yet been invented by the cultivators of this part of the country for their destruction, but that it is believed that continual heavy rains destroy them by plunging them under water, but it is left to nature to remove the pest. These insects do great damage to the paddy plants, but happily their ravages are confined to the younger and tender plants only.

From the larvæ and pupa sent I am able almost with certainty to identify the pest as *Suastus gremius*, Fabricius, a butterfly of the family *Hesperiidæ*, of the sub-order

Zoological position of the insect.

Rhopalocera, of the order *Lepidoptera*. This butterfly is very widely-spread, occurring throughout India except the desert tracts, and in Ceylon. The butterfly expands about an inch and three quarters, is of a glossy brown colour on the upper side, the fore wing with a pair of conjoined spots at the end of the discoidal cell, and a series of six spots curving round the middle of the wing (all these spots are pale yellow). The under side of the forewing is nearly similarly marked; but the hind wing, which is unspotted on the upper side, has about six small round black spots in the middle of the wing. The opposite sexes are almost exactly alike.

The earlier stages of this insect have not hitherto been published. I have repeatedly bred it (often from the egg) in Calcutta, where it feeds on the date palm. I was not previously aware, till reading the Tehsildar's report, that it had any other food plant. He says it only eats young paddy in the larval state; I rather doubt this, as if it will eat the particularly fibrous, dry, tough, and hard leaves of the date, surely it will eat too the older paddy leaves, which cannot compare in hardness to the date leaves at all ages. According to my observations the egg is laid singly on the upper side of the leaves of date palms, generally near the base of each subdivision or frond of the leaf. It is large, very hard, dome-shaped, widest at the base, rapidly decreasing in width towards the apex, much wider than high, the usual crater-like depression at the top (micropyle), from the edges of which proceed coarse ribs varying in number from twelve to fifteen, the usual number being fourteen; colour French-grey, just before the young larva emerges, turning to very delicate pale pink. Larva at first stage dull red throughout. When full-fed it measures just an inch in length when at rest; the body smooth, pale bluish-green, the segments denoted by pale yellowish lines and but slightly constricted, the whole surface covered with minute dark green spots, and crossed, especially at the constrictions dividing the segments, by fine depressed lines; a dark green dorsal line, the spiracles black. The body is nearly cylindrical, but tapers towards both ends, the anal segment flattened anteriorly. The head-case is hard and rough, covered with fine depressions, a double pale line across the crown and one at each side, the rest dark brown. Legs and under side of body pale green. The larva, when large enough, rolls up a leaf or else joins together two or three leaves, closing the edges by silk threads, but leaving an opening at each end. When quite small, it makes a shelter of a part of a leaf only. It comes out only to eat, as far as I have observed, and retreats into its shelter when its meal is over or if frightened, either backwards or forwards with equal celerity. The pupa is enclosed in a rolled-up leaf, the inside of which is lined with soft silk, out of which flies when opened a quantity of fine white waxy powder with which the pupa is thickly covered. The pupa is pale yellowish green,

the head very square and blunt, the eyes dark brown, but no other markings, the body quite plain and smooth throughout.

The Tehsildar says that this insect does "great damage to the paddy plants." I am inclined somewhat to doubt this fact. The butterfly is by no means a common one, and, as the paddy is growing for a part of the year only, the butterfly has a chance of perpetuating its race only by living on some other plants but paddy, as, when the latter is reaped, the insects living upon it, no matter in which stage, egg, larva or pupa, would be certainly destroyed. Any butterflies that might be on the wing would escape certainly, but they probably live but for a short time, certainly not till the next season's paddy has commenced to grow, so their only chance of perpetuating the race would be to lay their eggs on some other plant, which would almost certainly be difficult to find in suitable quantities. I think, therefore, except under most exceptional circumstances, the damage done to the growing rice would be but trifling, especially as it appears to eat the leaves only.

Hand-picking might be resorted to to destroy the pest, but would probably be too expensive. Both larva and pupa could be easily found, as they spin several of the paddy stems and leaves together to form their shelters. The simplest way to destroy the pest, and which would be absolutely effectual, would be to raise the earthen walls, or bunds, round the affected nurseries or fields, and submerge the rice under water for a short time. In no stage (except perhaps the egg) could the insect survive this drowning process, and it would do no harm to the rice.

A CEYLON CARDAMOM PEST (*Lampides elpis*, Godart).

Plate I, fig. 5, a, male imago; fig. 5, b, larva; fig. 5, c, cardamom capsules, two of which have been punctured by the larvæ,—all natural size.

Two reports only have been received regarding this pest. The first report is contained in a pamphlet entitled "Note on Cardamom Cultivation," by Mr. T. C. Owen (Colombo, A. M. and J. Ferguson, 1883), who notes—

"Of the *enemies* which attack cardamoms the most serious is an insect which bores a circular hole in the capsules and cleans out the inside; young plantations seem much more liable to this pest than older ones. In the former case as much as 80 to 90 per cent. will sometimes be attacked and destroyed in this way; proximity to patana seems also the cause of increased liability to these attacks. Applications of wood-ash, lime, or anything of a like nature, are said to be beneficial."

Mr. Owen failed to identify the insect which does the damage, and it has remained unknown till quite recently, when Mr. E. Ernest Green, of the Eton Estate, Pundul-oya, Ceylon, found a full-grown larva inside a capsule, and, on breeding it, found it to be *Lampides elpis*, Godart, a

common butterfly of the Indo-Malayan region belonging to the family *Lycænidae*. The second report above referred to consists of a letter from Mr. Green, dated 21st November, 1888, addressed to Mr. E. C. Cotes, of the Indian Museum, Calcutta, enclosing drawings of the larva and cardamom fruit (reproduced on Plate I), and a letter to the writer, dated 23rd December, 1888. He writes—

“It is a curious thing that, although the damage caused by the larva of this insect is so general, it was only after a long time and much trouble that I caught the criminal red-handed. I had for some time suspected this pretty little butterfly, as it haunts the cardamom clearings in large numbers. Other planters seem to have been equally unsuccessful in determining the cause of the damage. My drawing was made from a single specimen found *in situ* in the cardamom capsule. I unfortunately neglected to make a drawing of the pupa. The larva was full-fed at the time [of capture], and pupated almost immediately upon the side of the box in which it was confined. Since then I have failed in obtaining other specimens. This is probably because the insects are all now on the wing; the larval state, no doubt, occurs earlier in the year during the growth of the young fruit. At the time of the cardamom harvest, when one’s attention is more especially drawn to the damage, the insects have all vacated [the capsules], and are possibly lying as pupæ amongst the shrivelled leaves and stalks. When the next fruiting season commences, I intend to make a very careful search for the eggs and larva, and, if successful, will send you a series for examination. I do not think the larva attracts ants, or I should have noticed the ants frequenting the cardamom stools. In drawing the larva I did not notice any secretive gland or retractile tentacles. As regards the food of *L. elpis*, its natural food-plant is, no doubt, one or more of the allied *Scitamineæ*, which abound in all Ceylon jungles—*Curcuma*, *Amomum*, &c.”

With regard to Mr. Green’s remarks about ants, they are in reply to my questions on the subject. Many larvæ of the *Lycænidae*, including an allied species, *Lampides ælianus*, Fabricius, have two retractile tentacles on the twelfth segment, and a gland on the dorsal line of the eleventh segment, which latter, at the will of the larva, gives off a sweet liquid, of which ants are extremely fond; in consequence of this many species of *Lycænidae*, which possess this gland are most carefully tended and guarded by ants, who appear to make “cows” of them, much in the same way as they utilise *Aphidæ*, *Coccidæ*, &c. Mr. Green also notes that “Ordinarily from 5 to 10 per cent. of the fruit capsules are perforated by this insect.”

This pest is a butterfly of the genus *Lampides*, of the family *Lycænidae*, of the sub-order *Rhopalocera*, of the order *Lepidoptera*. The genus is a purely tropical and subtropical oriental one, and occurs almost throughout India, in Ceylon, in the Andaman and Nicobar Isles, in Burma and in the Malay Peninsula and Archipelago. The male butterfly is of a very beautiful, pale metallic azure-blue on the upper side, with a narrow black border to both wings; the hind wing has sometimes a series of black marginal spots, and there is always a short black white-tipped filamentous tail-like process to each hind wing near the anal angle. The female is pale dull (not metallic) bluish-white on the upper side, the outer black margins much broader, and the black spots on the margin of the hind

Zoological position of the insect.

wing considerably more prominent. The underside of both wings of both sexes is pale brownish, crossed by numerous more or less broken prominent white lines. The expanse of the open wings is about an inch and a half.

It is almost certain that this butterfly, at low elevations, flies all the year round, and that there are a constant succession of broods. The female probably lays her eggs on the flower buds of the cardamoms (*Elettaria cardamomum*), as is the case with another *Lycæn*id (*Virachola isocrates*, Fabricius) whose larva lives on fruit. The young larva emerges from the egg within a very few days and commences to eat the flower bud or young fruit, burrowing into its centre for that purpose.

Mr. Green describes the larva when full-fed as "dull, pale green, tinged with red on dorsal area; three reddish narrow dorsal stripes; spiracles minute, black; head small, brown, retracted beneath the second segment; length .55 of an inch. Pupa smooth, pale dull yellowish-brown, marbled and spotted with dark brown, spots coalescing into three irregular dorsal stripes." An allied species, *L. ælianus*, Fabricius, has been bred by the writer in Calcutta on the leaves of *Heynea trijuga*, Roxburgh, and in Java by Dr. Horsfield on *Butea frondosa*. It is most singular that two species of one genus should have such dissimilar habits. Only two other genera of Indian *Lycæn*idæ are known to live on fruits, *Virachola* with two species, *Deudorix* with one.

Within the fruit all its larval state is passed; it grows with the fruit and lives on the fruit entirely, probably never venturing outside unless the fruit to which it has hitherto been attached should for any reason become unsuitable to it, when it would seek a fresh one, and immediately bore into its centre. When full-fed, Mr. Green surmises that it leaves the fruit, and turns to a pupa or chrysalis amongst the shrivelled leaves and stalks. This is contrary to my experience of the habits of *V. isocrates* and *V. perse*, which, in nature, usually pupate within the fruit on which they have lived. The pupal state would last but a few days probably, when the butterfly would appear, and the second cycle of life begin by the females laying a new batch of eggs. As the cardamom grows, as far as I know, in South India and Ceylon only, it is certain that it cannot be the legitimate food-plant of this butterfly throughout its great range. Mr. Green, however, appears to have been the first to breed the insect, and thus to discover at least one of its food-plants. It is probable, like other pests, that *L. elpis* feeds upon some jungle plant, but that, finding the cultivated cardamoms quite to its taste, it has taken to them and rapidly increased in numbers, owing to its new food-plant being provided for it in such great abundance.

Mr. Owen estimates the damage done by this pest to be sometimes as much as 80 to 90 per cent. to young plantations. Mr. Green states that "ordinarily from 5 to 10 per cent. of the fruit capsules are perforated by this insect."

Damage of the pest.

Mr. Owen states that "applications of wood-ash, lime, or anything of a like nature are said to be beneficial." It should be remembered that Mr. Owen did not know what insect constituted the pest, nor its life-history. I imagine his remedy is meant to be applied to the earth surrounding the plants, which might keep away slugs and worms, but would be absolutely useless in the case of this insect. The only remedy I can suggest is to catch and kill all the butterflies that can be seen. Small boys, provided with butterfly nets, should be able to satisfactorily account for the greater number of butterflies frequenting a given area, to prevent the females laying their eggs being the object of the slaughter. The butterflies have a slow, flapping flight, and are very conspicuous, so their capture is very easy. Once the eggs are laid no further remedy is possible, I think. To prevent the increase of the butterfly it would be advantageous to hunt for, and collect, all the capsules with holes in them, and to destroy them by fire or burial. This search for affected fruits would, however, be very tedious and expensive, so I fear impracticable. To kill one gravid female butterfly, with perhaps two or three hundred eggs in her body, each egg representing the loss of a capsule, would be a much more effectual remedy.

FURTHER NOTES ON INSECT PESTS.

BY

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ASSISTANT IN THE INDIAN MUSEUM, CALCUTTA.

1.—FURTHER NOTES ON THE WHEAT AND RICE WEEVIL¹.

FROM inquiries made in the early part of 1888, there appeared to be a somewhat widespread idea that, although wheat is apparently free from weevil when it leaves the fields and village granaries, yet, that it will invariably develop weevil whenever it is stored so as to be exposed to the air, quite independently of any further contamination by weevils.

This idea may be accounted for by the fact that, after the eggs are laid, a certain period elapses before anything is seen of the resulting weevils, and consequently that grain, stored in a perfectly new and clean godown, may develop weevil owing to its having been already contaminated when it was put there, though to all outward appearance it was perfectly clean. It appeared, however, of importance to settle the question definitely, for it is evident that, while, on the one hand, isolating and disinfecting store-houses, to get rid of the weevil, will be of no use whatever if the eggs are already laid in the wheat when it leaves the fields; on the other hand, if the weevil is a purely store-house pest, the isolating and disinfecting of the store-houses seems to be the most rational method of dealing with it.

With a view therefore of settling the question, the Directors of Land Records and Agriculture in the North-Western Provinces and Punjab sent down, last hot weather, to the Museum, a series of half maund samples of wheat, and besides these the writer obtained a few small samples, which were rubbed out by hand from the ear, in his presence, at the experimental Farm at Cawnpore. These samples were distributed to different places where there were thought to be no weevils, and exposed to the air, throughout the whole of the rains, in order to ascertain to what

¹ For a general account of this insect (*Calandra oryzae*) see No. I of "Notes on Economic Entomology, 1888."

extent they would be attacked. On the 14th of November, when the rains were well over, a small sample of each was closed up and sent to Mr. H. M. Ross, who had kindly undertaken to furnish a report.

The experiments are not so definite as could be wished, and it will be well to repeat them through another year; but they seem to indicate pretty clearly that, when taken fresh from the field and carefully isolated from contamination by weevils, although exposed to the air, wheat can be indefinitely preserved from attack, and hence that the weevil does not deposit its eggs while the grain is standing in the ear in the fields. At the same time, however, the experiments clearly show that while it is easy enough to preserve hard red wheat, the very greatest precautions have to be taken in order to preserve soft white wheat from attack.

It should be noticed that in the case of samples (especially of the soft varieties) reported upon as 'practically undamaged but with a few stray weevils in them,' these weevils could only have been introduced late in the rains; for had even one or two weevils succeeded in laying their eggs in the wheat, before it reached the Museum, they would have occasioned appreciable damage, owing to the rapidity of their reproduction. The writer, therefore, concludes that during the latter part of the rains, a few stray individuals, from the badly infested samples, found their way into the clean samples, which were deposited in different parts of the Museum and No. 1, Sudder Street, in places supposed to be well isolated, but which in reality were not sufficiently removed from infested quarters.

The following is a detailed account of the experiments, with the remarks made on them by Mr. H. M. Ross:—

EXPERIMENT 1.

Samples A, B, B2, and N, were rubbed out from the ear at the Cawnpore Experimental Farm on 28th March 1888, were unpacked and exposed to the air in small bottles on the 27th April, and were kept until the end of September in No. 1, Sudder Street, where they were thoroughly isolated; they were sent in the end of September, during the writer's absence, to the Entomology room in the Museum, and thus exposed for a short time to possible contamination by weevils.¹

Mr. Ross reports on them in November:—

"Sample A. soft white wheat, with admixture of about 20% of hard,—contains one or two live weevils; no real damage done.

"Sample B. Soft white wheat, with small admixture of hard grains and barley. Has evidently been damp from exposure in the rains. No damage from weevils.

"Sample B2. Practically identical with sample B.

"Sample N. Soft white wheat, with admixture of reddish grains. No damage from weevils."

¹ Weevils are not very active so late in the rains, but this exposure is, in the writer's opinion, sufficient to account for the few stray weevils found in the samples in November.

EXPERIMENT 2.

Sample M was obtained at the same time as samples in experiment No. I. But early in the rains it was sent to the Entomology room, where it remained throughout the whole of the rains, within easy reach of stray weevils.

Mr. Ross reports on it in November:—

“Sample M quite rotten and full of weevils.”

EXPERIMENT 3.

Sample D, taken on 14th November 1888 from a half-maund tin of that year's wheat, which was received from the Director of Land Records and Agriculture, North-Western Provinces, in May, and was exposed to the air in the Museum, in a well isolated position, from May to November.

Mr. Ross reports on it in November:—

“Soft white wheat, with small admixture of hard grains; the soft grains, almost without exception, badly weevilled; the hard grains mostly free from weevils.”

EXPERIMENT 4.

Samples E and F were taken on 14th November 1888 from two half-maund tins of that year's wheat, received from the Director of Land Records and Agriculture, North-Western Provinces, on 12th June, and exposed to the air throughout the whole of the rains in the Museum verandah, where they were well isolated from weevils.

Mr. Ross reports on them as follows:—

“Sample E, hard, white wheat, known in Calcutta as ‘Allyghur quality’ (from the district where it is largely grown); no signs of weevilling. Have never seen any sample or bulk of this quality containing weevils.

“Sample F, soft, white wheat, with hardish shell, contains one or two weevils but no real damage done.”

EXPERIMENT 5.

Sample K, was taken on 14th November 1888 from a tin of wheat, which was received from the Director of Land Records and Agriculture, Punjab, on 25th May (marked new wheat from a threshing floor); it was exposed to the air throughout the whole of the rains in No. 1, Sudder Street, where it was well isolated.

Mr. Ross reports on it as follows:—

“Sample K, hard, red wheat (gunja jelli); have never known pure gunja jelli to weevil.”

EXPERIMENT 6.

Sample L was taken, 14th November 1888, from a tin of old wheat from a godown in Sialkot. This tin was received from the Director of Land Records and Agriculture, Punjab, on 25th May, and was exposed to the air, throughout the rains, in the Entomology room, where it was not isolated from weevils.

Mr. Ross reports on it in November as follows:—

“Sample L, old wheat, with small admixture of barley, both alike destroyed by weevils.”

EXPERIMENT 7.

Samples H, H2, and G, were taken on 14th November 1888 from three half-maund tins of wheat, received from the Director of Land Records and Agriculture, North-

Western Provinces, on the 2nd July 1888; these tins had been exposed to the air throughout the rains, in different parts of No. 1, Sudder Street, where they were well isolated.

Mr. Ross reports on them in November as follows:—

“Samples H and H2, mixed hard and soft white wheat, with further admixture of gunga jelli (hard red), contains one or two weevils, but no real damage done.

“Sample G, hard red wheat (gunga jelli), with small admixture of soft white grains; one or two weevils visible. Have never known *pure* gunga jelli to weevil.”

Mr. Ross remarks:—

“The foregoing results agree with the experience of the trade, *viz.* hard wheats are practically safe from the attacks of the weevil; of the soft wheats samples A, B, B2, and N, rubbed out from the ear by hand and isolated since March last, have practically escaped damage. Sample D, of similar quality, wheat is badly weevilled, with the exception of its hard grains, which have escaped.

“If stored in ordinary godowns during the past season, specimens A, B, B2, J, N, and possibly F, would have weevilled as badly as D.

“Nothing would be gained by extending the time during which these samples were exposed. If wheat escapes the weevil during the rains, it will suffer but little afterwards.”

EXPERIMENT 8.

Besides the samples above noticed, there were two half-maund tins of new wheat (one being soft white and the other hard red), which were received in May from the Director of Land Records and Agriculture, North-Western Provinces and Oudh. These were exposed to the air, in the Office of the Revenue and Agricultural Department, Calcutta, where they were thoroughly isolated from the time they were received until 20th December.

Mr. Ross reports on them in December:—

“Both are quite free from weevils, and the white wheat is ‘*superior quality soft*’ white wheat. The isolation seems to have been quite effective in these cases.”

EXPERIMENT 9.

Some ears of very soft-bearded wheat, and some ears of barley were brought down from Cawnpore in April, and exposed to the air in Calcutta in the Entomology room (within easy reach of loose weevils) throughout the whole of the hot weather and rains. On examining them in November, the grains of wheat in the ear were all untouched by weevil, while the barley, which had been obtained at the same time and kept under precisely similar conditions, was badly weevilled.

The following extracts are taken from a letter, dated 29th August, 1891, from the Agricultural Officer of Ranchi, which has been forwarded by the Director of Land Records and Agriculture in Bengal—

“The rice weevil is never met with in the open. However minute it might be, it could not possibly escape detection if it was in the habit of frequenting rice fields while laying its eggs.

“So far as my inquiries go, the weevil is never found in paddy (*i.e.* unhusked rice) however long it may have been kept in the granary. If the eggs were laid, as is sup-

posed by people, while the rice was still in the husk, paddy would be equally subject to the attacks of the weevil.

"It is well known that *siddha* rice (*i.e.* rice which has been steeped for an hour or so in water at nearly boiling) is infested by the weevil to the same extent as *atap* (or unsteeped rice): a fact which shows beyond doubt that the eggs could not have been laid while the rice was still in the husk, for in that case they would have lost their vitality during the boiling operation.

"I have examined several samples of rice retailed in the Ranchi market by petty dealers from neighbouring villages: all these were singularly free from weevils, a fact which can be explained by supposing greater cleanliness observed by villagers in the matter of storing the grain, but which is mainly attributable in my opinion to the habit of keeping rice always in the husk till it is required for sale or private consumption."

The following extract is taken from Mr. W. S. Price's report of experiments made in the Bigapur district to test the efficacy of bisulphide of carbon in protecting grain from weevil.

Bisulphide of carbon.

The report has been received from the Director of Land Records and Agriculture, Bombay, who adds that the experiments were undertaken at the suggestion of the Government of India.

The experiments in this case show the failure of this chemical to protect Jowari grain from the attack of weevil.

The wheat weevil, *Calandra oryzae*, has hitherto only been definitely recorded as attacking wheat, rice, maize and barley; but it seems probable that it is the one here mentioned as attacking Jowari grain (millet):—

Dharwar, 22nd August 1888.

"I made two experiments in December last in the Hugund Taluka with the bisulphide of carbon that was sent to me, one in the town of Ilkal, and the other in the town of Hungund. The reports from the Mamledar of Hungund show that the Jowari grain experimented on has been attacked by weevil.

"For the experiment in Ilkal, about 320 lb of new Jowari were stored in a wicker-basket, shape and size of a cask. The basket was well plastered with a mixture of cowdung and earth. About 3¼ oz. of the chemical were plunged into the grain to about half-way down into the basket in the way directed in the Government Resolution, No. 6093, dated 9th September last. The mouth of the basket was then closed by a deep plaster of mud, a layer of leaves of the neem tree being placed between the grain and mud plaster. The experiment in Hungund was conducted in the same way, and on the same kind of grain. The amount of grain used was 336 lb, into which about 4 oz. of the chemical were placed."

Sulphur fumes.

With regard to sulphur fumes for killing weevils, Dr. Giles, of Hoshangabad, writes on the 22nd September—

"The weevil has attacked my store of grain in the prison, and I first tried sulphur fumes. The godown, however, was too large to be sufficiently tightly closed, and

though a good many were killed, a good many survived—the greater number I think. I am now trying neem leaves, and I am inclined to think it will answer, but will let you know when sufficient time has elapsed to test the question.”

The weevil in Burma. The Director of Land Records and Agriculture,
Burma, writes—

“In Lower Burma the Burmans do not, as a rule, keep clean rice for long. But in Upper Burma it is largely stored. The merchants” (in Mandalay) “told me that they suffered great loss from weevils and would gladly try any insecticide that Government recommended. The rice is usually kept in gunny bags containing 225 lb of rice each.”

A series of reports on weevil in unhusked rice has been received from the Director of Land Records and Agriculture in Burma.

The reports are in the form of extracts from letters from Messrs. Bullock, Brothers & Co., and the Deputy Commissioners of the following places, Hanthawaddy, Prome, Pegu, Bassein, Irrawaddy, and Thongwa. It seems unnecessary to give the reports in full, but, while some of them notice damage in unhusked rice by weevils, the majority of them may be summed up in the words of the Deputy Commissioner of Pegu, who writes:—

“Weevils do not do any appreciable damage to paddy, apparently because the outer husk is very hard. When rice is stored for some time after being husked, weevils attack it, but the Burmans are not in the habit of storing husked rice. They do not want any insecticides.”

This agrees with experience in Bengal, and it would seem probable that in the cases when unhusked rice is attacked by insects, the damage is done by a species of grain-moth, which is often to be found in large numbers, and not by the weevil, which only attacks the rice after the removal of the husk.

The weevilling of rice
in England.

Mr. H. M. Ross writes—

“You will recollect that I promised to ascertain what I could for you concerning the weevilling of rice in warehouses at home. My correspondent writes as follows:—‘Of the dock gentlemen and wharfingers to whom I spoke, many refused to admit that rice weevilled at all—and getting statistics on the subject I found to be totally out of the question, as none exist. However, the more experienced allow that in damp weather rice does weevil to a certain extent, but it is under 1 per cent. per annum (*i. e.* the loss in weight from weevilling). One instance I had given me where the rice had been warehoused for four years and there was absolutely no sign of weevilling whatever.’”

Note.—This illustrates how susceptible the weevil is to cold, for however clean the rice may be when it is put on board in Calcutta, at least a few weevils are almost always to be found in it, and these, under the conditions of the Calcutta climate, would very soon affect the whole shipment. Miss Ormerod has observed what a slow and difficult process it is

for the weevil to develop in wheat after it reaches England ; and the same would seem to hold good with rice.

With regard to the question of how the weevil passes the hot weather
 The weevil in the hot in the North-West Provinces, where the godowns
 weather in the North- become excessively hot and dry, the Secretary to
 West Provinces. the Government of India, in the Revenue and Agricultural Department,
 has forwarded the following note by Mr. G. Cane, who writes from Delhi
 on 16th July:—

“A wheat weevil “sursi” (red) was found alive on a wall of a godown early in June before any rain fell. Also a “goon” (black), which frequents gram and other grain, was found similarly. Although most of these weevils die in the hot months, it is evident a few survive. The godowns are now crowded with them.

Mr. J. Blackwood writes¹ that he hears from one of the leading rice
 A Demerara remedy. importers in Demerara, that there they attract ants
 to the rice piles by sugar, and the ants destroy the
 weevils. (See the action of ants in Demerara in protecting sugarcane
 from Borer moth, p. 26.)

Conclusions.

In the above correspondence and experiments the points which seem to be chiefly of importance are as follows:—

- I.—The confirmation of the theory that the weevil is a purely granary-pest, and that grain can therefore be preserved by isolation, and other precautions against infection, after it leaves the fields; the hard varieties, of wheat being easily protected, while in the case of the soft varieties, which offer less resistance to attack, protection from infection, though possible, is a matter of very considerable difficulty.
- II.—The observation of the wandering propensity of the weevil, which makes perfect isolation very difficult to obtain in the neighbourhood of infested localities.
- III.—The confirmation of the supposition that rice is free from the attack of weevil so long as it lies in the husk, which seems to be an efficient protection.
- IV.—The observation that the weevil does not develop to any considerable extent in grain after it reaches England.
- V.—The doubt which has been thrown upon the efficacy of any of the substances, bisulphide of carbon, neem leaves, and sulphur fumes, to preserve grain that lies in an infected store-house.
- VI.—The observation that in the case of wheat the ear is a protection against weevils, while barley is as much subject to attack when in the ear as when taken out of it.

¹ Letter dated Calcutta, 15th January, 1889.

2.—THE SUGARCANE BORER MOTH.

Diatraea saccharalis,¹ Fabr.

Plate II, fig. 2 a moth, b larva (dorsal view), c larva (side view), e pupa (all natural size); fig. 2 f pupa (enlarged), g piece of sugarcane (natl. size) to show tunnels.

The larvæ of this moth bore into the stalks of sugarcane, often thereby setting up putrefaction, so that the whole stalk becomes worthless.

It has not yet been satisfactorily determined whether the sugarcane borer, found in different parts of the world, belongs exclusively to a single species, or whether there are several closely allied species, all of which damage sugarcane by boring into it. Until, therefore, this question has been definitely settled the Fabrician name of *saccharalis* may continue to be applied² to the pest wherever it occurs, and the insect may be determined zoologically as a Pyralid moth, belonging to the genus *Diatraea* and to the species *saccharalis* of Fabricius.

Sugarcane, in different parts of the world has, for at least the last hundred years, been known to be subject to the attack, either of this pest or of others so closely allied to it as to be scarcely distinguishable from it, and during the last year information has been sent to the Museum of damage done to sugarcane in several parts of India, where the pest would seem to have long been known, though but little has been recorded concerning it.

In 1857 Babu Joykissen Mukerji described³ the total destruction, by the pest which he calls 'dhosah,' of an imported variety of sugarcane (known as the Bombay or red sugarcane) in the districts of Rungpur, Hooghly, and a portion of Burdwan. The cultivation of this variety had been carried on for some years, and had proved very profitable, but when the pest appeared its cultivation had to be entirely given up, as it was found to be very much more subject to attack than the country varieties of cane.

In the Indian Museum are specimens of the pest, which were received in 1885, with the information that the insect had done great injury to sugarcane in Dhulia.

In 1888, the Personal Assistant to the Director of Land Records and Agriculture, North-Western Provinces, wrote⁴ that the pest, which ap-

¹ The thanks of the writer are due to Mr. R. Blechynden, of the Agri-Horticultural Society of India, for help in hunting up the previous history of this pest.

² This is the view taken by Dr. Riley in his paper on the pest in the Entomology Report of the U. S. Department of Agriculture, 1880, page 240.

³ In a paper published by the Agri-Horticultural Society, India, Volume IX, page 355 (1857).

⁴ In a letter dated 1st September.

pears in dry seasons, had destroyed as much as a fourth of the sugarcane crop in the neighbourhood of the Cawnpore Experimental Farm.

The Special Manager of the Dhaukora Wards Estate writes ¹ that the pest, which is known locally as *Mandaruah*, has this year (1888) done injury to the sugarcane crops in several parts of the estate.

The Collector of Ganjam also notices ² injury done by this insect, which is known as *Monjikila purugu*.

The Agricultural Officer of Burdwan and Seebpur, writes ³ that the loss occasioned by the pest, sometimes amounts to fully one-fourth of the cane crops of a neighbourhood.

The pest in other parts of the world. With regard to injury by the pest in other parts of the world :—

In the year 1750 Hughes mentions ⁴ injury done to the cane in Barbadoes by the larvae of small moths which are likely to have been the same as the borer.

Porter notices ⁵ that the pest was found fatally destructive in Guadeloupe in 1785 and 1786.

Beckford notices ⁶ the presence of the borer in Jamaica in 1790.

In 1828 the Revd. L. Guilding wrote ⁷ an account of the borer in St. Vincent, describing it as *Diatraea sacchari*.

Westwood mentions ⁸ the pest as destructive to sugarcane in Jamaica in 1841.

About the year 1856 the insect did great damage to cane in Mauritius, ⁹ into which island it was supposed to have been introduced from Ceylon.

In 1857 the borers were very abundant along the Lower Mississippi in the United States.¹⁰

About the year 1879 the borer did great damage to the sugarcane crop in British Guiana.¹¹

¹ In a letter dated 23rd September to the Collector of Mymensingh that was forwarded by the Director of Land Records and Agriculture Bengal.

² In a report forwarded by the Revenue and Agricultural Department.

³ In a letter dated 4th July which was forwarded by the Director of Land Records and Agriculture, Bengal.

⁴ See Roth's Animal Parasites of the Sugarcane, page 12, (1885).

⁵ "Nature and properties of sugarcane," by G. R. Porter, London, (1830).

⁶ See Roth, Animal Parasites of the Sugarcane, p. 8, (1885).

⁷ Trans. Soc. Arts., Vol. XLVI, p. 143, (1828).

⁸ *Gardener's Chronicle*, 5th July 1856, page 453.

⁹ Bojer's Report of the Select Committee appointed to examine the extent of the damage done by the cane-borer in Mauritius, 1856; reprinted in the *Sugarcane* for 1873, (see Roth's Parasites of the Sugarcane).

¹⁰ See Dr. Riley's paper in the Entomology Report of the U. S. Department of Agriculture, 1880, page 240.

¹¹ See papers by Miss Ormerod in Proc. Ent. Soc. Lond. 1879, pp. 33 and 36; and 1880, page 16.

In 1880 Dr. Riley reported ¹ on the insect as injurious in the United States.

In 1885 Mr. H. Ling Roth described ² the insect as occasionally very destructive to sugarcane in Queensland, Australia.

The Agricultural Officer of Burdwan and Seebpore writes ³—

“The sugarcane planting season extends from the beginning of February to the end of May. If there be no rains ⁴ in April or May, and if the cane fields are not frequently irrigated, which, from the scarcity of water at this time, is hardly possible, the pest makes its appearance. The pest first shows itself by the drying of the middle stalk of the plant, and is hence called by the ryots the *Majera* (a Bengalee term meaning relating to the middle); on pulling, the stalk now easily comes out, and its lower end is found to have become a rotten mass. Very soon the whole plant dies away, and from the root stock a number of smaller plants make their appearance to be in their turn attacked by the worm. If the rains hold off a long time, or if the fields are not thoroughly irrigated, three or four generations of plants are in this way attacked and destroyed. At last, when the rains set in, the fields become free from the insect, and a number of sickly-looking cane plants shoot out, but these make very little progress and never attain the proper size of the cane plant. If only one generation of plants is lost, and if this happens at an early stage of the growth of the plant, the damage done is not much.”

Nature of the injury in India.

The life history of the insect has not yet been fully studied in India, but what has been observed agrees so closely with the observations made on the corresponding sugarcane pests of other parts of the world, that we may safely infer the rest, and the following account therefore is taken from Dr. Riley's paper ⁵ on the pest in America, where, however, the insect is likely to take rather longer to pass through the various stages of its existence than in the warm climate of India.

The parent moth lays her eggs upon the leaves of the young cane near the axils, and the young borer, hatching in the course of a few days, penetrates the stalk at or near the joint, and commences to tunnel through the soft pith. The eggs are flat and circular, one twenty-fifth of an inch in diameter, and are white when first deposited, turning yellow as they

¹ Riley, l. c.

² See his ‘Animal Parasites of the Sugarcane.’

³ In a letter dated Calcutta 4th July, which has been forwarded by the Director of Land Records and Agriculture, Bengal.

⁴ It is noticeable that while considerable injury by the pest is almost universally supposed to take place only when moisture is deficient, Ling Roth, in his account of the pest in Australia notices particularly that the pest occurs in “wet springs.” (See his ‘Animal Parasites of the Sugarcane’)

⁵ Report, U. S. Department of Agriculture, Entomology, 1880, p. 240.

approach the hatching point. The growth of the borer worm must be very rapid, less than thirty days being probably occupied in the larval state. The borers are quite active, and occasionally leave their burrows and crawl about upon the outside of the stalk, seeking another place to enter. The full-grown borer is about an inch long, rather slender, nearly cylindrical, and cream white in general colour, but speckled¹ with black spots with a yellow head and black mouth-parts. Upon attaining its full size, it bores to the outside of the cane and makes a large round hole for its future exit—a hole which is usually at least one-fifth of an inch in diameter. It then retires into its burrow and transforms, a short distance from the opening, into a slender brown pupa,² three quarters of an inch long. The pupa state lasts but a few days and then the moth makes its exit. The moth has a spread of wings of about an inch and a quarter, and is of a light, greyish-brown color. With the female moth the hind wings are of nearly the same color with the fore wings, but with the male the former are silvery white. There are several broods in the course of the season, and the insects hibernate almost exclusively in the larval or “worm” state. During the winter they are to be found most abundantly in the seed cane, but also in the discarded tops, and to a slighter extent in the stubble.

The Agricultural Officer of Burdwan and Seebpore notices³ that he has

Food plants of the worm other than sugarcane. seen the Kash plant (*Saccharum spontaneum*), attacked by the insect in the same way as sugarcane is attacked. Specimens of what appear to be

the larvæ of the sugarcane borer have been received from the Collector of Ganjam, who writes⁴ that they destroy paddy and brinjal plants, besides sugarcane. Similar specimens have also been received from the Agricultural Officer of Ranchi, who reports them as injurious to brinjal; and from Mr. Woodrow, of Poona, where they bore into jowari stalks and are said to make the plant poisonous to cattle. (See p. 28.) Dr. Riley notices⁵ a very closely allied, if not identical, insect that bores into corn (maize) stalks in America.

In British Guiana⁶ the pest is subject to the attack of ants which

Parasites and natural enemies of the pest. live in the cane fields, and are supposed to wage continual warfare against the borers; and in Mau-

¹ Dr. Riley found that the black speckles were not always present, but the specimens sent to the Museum have them plainly visible.

² The insect which damaged sugarcane in Mauritius about the year 1856 is said (see Bojer's Report) to have spun itself up in the leaves of the plant instead of transforming into a pupa in its burrow. In the case, however, of the insects reared in the Museum, the pupæ were formed in the burrows in the cane.

³ In a letter dated Calcutta, 4th July, forwarded by the Director of Land Records and Agriculture, Bengal.

⁴ In a report forwarded by the Revenue and Agricultural Department.

⁵ Report of U. S. Department of Agriculture, Division Entomology, 1880.

⁶ See Miss Ormerod's paper in Proc. Ent. Soc., Lond., 1879, p. 33.

ritius the chrysalids of the borer were found to be subject to the attack of mites; no evidence has yet been obtained of any effect produced in either of these ways upon the numbers of the sugarcane pest in India, though the writer has observed large numbers of a chalcid fly which is parasitic upon the allied, or identical, jowaree borer. (See p. 29.)

A large number of remedies have been proposed for the pest, and it seems to be pretty well established that it can be to a great extent controlled by the burning or burying all the discarded tops, and clearing the fields of all waste sugarcane stalks after the crop has been taken; for, as the insect passes the winter as a larva inside the sugarcane, if these are destroyed, there are no moths in the spring to lay the eggs which produce the next year's "borers." The waste tops, however, should be carefully gathered together and removed from the field before being burnt, for if they are burnt carelessly, on the field itself, many predaceous insects will be liable to be destroyed, which take shelter in the ground and assist in reducing the numbers of the pest.

The following may be noticed among the remedies that have been suggested:—

Guiling recommends¹ that all the dry and useless leaves, under which he says the moth lays its eggs, should be stripped off: he claims that this treatment has been found effective in removing the pest.

Porter quotes² the practice of "introducing a pinch of quicklime into the heart of the young cane" for the destruction of the pest.

Westwood notices³ that in Jamaica in 1841, the ravages of the borer were to a great extent checked by allowing the refuse to accumulate upon the grounds, and burning them there, the old roots subsequently throwing up more vigorous shoots.

Miss Ormerod,⁴ in writing of the pest in British Guiana about the year 1879, quotes the practice of cutting back the cane below the surface of the ground, covering the plant with mould, and adding a handful of lime. The cutting out of the affected canes was tried on one estate over 246 acres, the result being considered satisfactory. In this case the canes cut out were put through the mill, and sufficient rum and megas obtained from them to pay expenses. Miss Ormerod also quotes the practice of steeping the cane for 48 hours in water before planting it, a treatment which was thought on one plantation, where it was tried, to destroy the hybernating larvæ without injury to the cane. It appears from the inquiries instituted in British Guiana, that it is a mistake to burn the refuse sugarcane on the fields themselves, as this destroys the ants, which, when unmolested, rendered valuable assistance in keeping down the pest. The plan therefore approved was to burn the refuse cane after collecting it in heaps outside the fields.

Dr. Riley recommends⁵ burning all "tops" during the winter so as to destroy the larvæ which hybernate in them; selecting seed cane from the least infested portion of the plantation and laying it down in furrows during the winter, covered with earth as deeply as should be found possible without inducing decay, and only uncovering it as

¹ Trans. Soc. Arts, Vol. XLVI, p. 43 (1828).

² Nature and Properties of Sugarcane, by G. R. Porter, London, 1830.

³ *Gardener's Chronicle*, 5th July 1856, p. 453.

⁴ Proc. Ent. Soc., Lond. 1880, p. 16; and 1879, pp. 33 and 36.

⁵ In his report on the insect.

it is wanted in the spring for planting out, thus preventing the egress of moths from the larvæ which have hibernated in the seed cane.

Roth writes that ¹ "he has kept the pest under control in Queensland by sending boys with sharp pocket-knives along the rows of cane. The boys spotted the dead or dying shoots and cut them off as close as possible to the parent cutting. They then opened the shoot and destroyed the fat grub. In some cases, however, the grub had migrated to a fresh shoot which as yet did not show any sign of decay, and thus escaped." Roth adds that "while dirty fields were being destroyed wholesale by the grub, clean fields were not infected to any such extent."

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Boger's Report of the Select Committee appointed for the purpose of examining the extent of the damage caused by the cane-borer in the Mauritius, 1856.²

Westwood's papers in the *Gardener's Chronicle*, dated 5th July 1856, p. 453, and in the Journal of the Linn. Soc. Lond., 1857, p. 102, on the borer in Mauritius.

Gill's paper in "*The Sugarcane*," August 1879, on cane-borers.²

Fabricius (J. C.) Beskrivelse over den skadlige sukker og Bomuldsorm i Vest Indien, og om *Zygaena pugionis* Forvandling (*Phalaena saccharalis*, *Noctua gossypii*.) In Skrifter of Naturhist Selsk, 1794, Bd. 3, Heft. 2, p. 63—67; Extr. Bullet. Soc. Philom. 1792, T. 1, p. 28, Götting Journ. 1798, Bd. 1, Heft. 1, p. 137—143. (See Hagen's Bibl. Ent., under Fabricius, No. 15.)

Beckford's descriptive account of the Island of Jamaica, published 1790, Vol. II, pp. 52—54.²

Hughes' "Natural History of Barbadoes" Fol. London, 1750, pp. 245—247.²

¹ In his "Animal Parasites of the sugarcane," p. 12, 1885.

² Not seen by the writer.

3.—THE SORGHUM-BORER.

Mr. G. Marshall Woodrow, of Poona, has forwarded ¹ some stalks of *Sorghum vulgare* (Great Millet, *jowaree* or *juár*) injured by an insect which is said to be very destructive in the Deccan, and is believed by the ryots to be poisonous to cattle. In the account of *Sorghum vulgare* in "Field and Garden Crops," page 27, Duthie and Fuller write :—

"The most peculiar disease to which *juár* is liable is that which makes the young stalks poisonous to cattle if eaten by them when semi-parched from want of rain. Of this fact there can be no doubt; in the scarcity of 1877 large numbers of cattle were known to perish from this cause, their bodies becoming inflated after a meal of the young *juár* plants, and death ensuing shortly afterwards, apparently in severe pain. A good explanation is not, however, forthcoming. The opinion universally accepted by natives is that young *juár*, when suffering from deficiency of rain, becomes infested with an insect called *bhaunri*, to which its poisonous effect on cattle is due. Immediately rain falls the insect is said to perish, and unless the ears have appeared before the rain failed, the crop often recovers itself and yields a good outturn of grain."

The *juár* stalks were in a rotten condition when received in the Museum, but they were found to be tunnelled by a caterpillar, much in the way that sugarcane is tunnelled by the sugarcane-borer *Diatraea saccharalis* (see p. 22). The remains of the caterpillar, chrysalis, and imago of a small moth were also found amongst the stalks, but they were all in much too bad condition to determine definitely: as far as could be made out, however, they were very similar to the sugarcane-borer. In this connection it may be noticed that the sugarcane insect occurs in dry weather, the plants recovering, if not already too far gone when rain falls, just as Duthie and Fuller describe to be the case with the *juár* plants. The sugarcane-borer sets up putrefaction in the sugarcane stalk, and it is not improbable but that the *juár* insect may have a similar effect on the *juár* stalks, thus rendering them hurtful to cattle. The matter would seem to be of considerable interest, it is hoped therefore that better specimens of the insect, in all stages of development, may be sent to the Museum for comparison with the sugarcane insect.

Since the above was written, further specimens of the affected *Sorghum* shoots have been received from Mr. Woodrow. These were found to be tunnelled, and the base of the top shoots had become rotten and infested with dipterous larvæ, precisely as is the case with sugarcane attacked by the borer moth. On comparing the boring caterpillars taken from the *Sorghum* shoots with spirit specimens of the larvæ of the sugarcane moth, the two were found very similar in general size, coloration, and markings; there were, however, a few minor points, in the markings, in which they were slightly different from each other.

¹ Received 24th December 1888.

This difference was not more than might be accounted for by individual variation in one species, but sufficiently long series of specimens of the two insects were not available to ascertain to what extent individual variation obtains in them.

In a large percentage of the tunnels the place of the boring caterpillar was found to be taken by several small silken cocoons of a chalcid fly which, no doubt, had destroyed the caterpillar; from the frequency of its occurrence in the shoots examined, this parasite seems likely to have a considerable effect in reducing the numbers of the pest.

Two live caterpillars were obtained from the *Sorghum* shoots. These were immediately transferred to sugarcane shoots to endeavour to rear them; they both burrowed eagerly into the sugarcane and appeared to thrive there; one of them, however, has since fallen a victim to the chalcid parasite whose eggs it must previously have harboured, but the second caterpillar is thriving,¹ and may yet turn into a moth, from which the identity of the species can be definitely determined. Some of the chalcid parasites are also being reared for a like purpose.

4.—A CATERPILLAR INJURIOUS TO TEA AND SÂL.

Dasychira thwaitesii, Moore.

Plate III, fig. 1, a imago ♀, b imago ♂, c cocoon in tea leaf, d pupa, e larva (dorsal view), f larva (side view), all natural size; fig. 1, g *Chalcis euplœa*, Hope (enlarged); fig. 1, h *Perilampus*, new species (enlarged).

Caterpillars and cocoons of this insect were forwarded to the Museum in February 1888 by Mr. Trotman of the Planters' Stores Agency, who writes—the caterpillars “have lately visited our Eastern Dooars tea garden in such quantities as to cause serious damage to the leaf of the tea shrubs.”

In the *Indian Forester*² is an account by Mr. W. R. Fisher of a caterpillar that defoliated sâl trees in the Eastern Dooars and Goalpara in 1878, and which appears to be the same insect.

Mr. Fisher writes that, in the commencement of October 1878, every leaf of the sâl trees, in a forest of about two hundred square miles in extent, had been devoured. In this tract, which is situated on a raised plateau of red loam and gravel, and is called the Purbotjuar and Guma forests, and in which sâl almost everywhere constitutes the predominant species, the foliage was so completely destroyed that the sâl trees were rendered perfectly bare of leaves, and the ground was strewn with their débris, and with the caterpillar's dung.

¹ It afterwards transformed into a pupa and was apparently healthy until accidentally injured, in transferring it to fresh sugarcane. It is hoped that the next attempt to rear the moth, may be more successful. The chalcid parasite has been successfully reared and will be sent to Europe for precise determination.

² Vol. VI, p. 243, (1881).

The caterpillars, however, prevailed over a much larger area, the more westerly forests in the plains of the Eastern Dooars suffering the most. Other trees were also attacked, especially *Careya arborea*, and even the tea plants of a garden which had lately been opened out in the neighbourhood of the forest. From some of the villagers Mr. Fisher also learnt that there had been similar attacks of caterpillars within their memory.

Mr. Fisher observed that a large portion of the Sidli forests escaped damage, and that elsewhere patches where the forest growth was densest and finest, and probably the soil and air dampest, had also escaped, while in forests of more scattered growth, and where trees had been damaged by jungle fires, the leaves were all stripped off. This, Mr. Fisher thinks, may perhaps have been due to the inability of the caterpillar to feed upon leaves full of strong acrid juice which would be found in the more vigorous portions of the forest.

The insect belongs to the Bombyces moths of the family Liparidæ and has been described¹ by Mr. Moore as *Dasychira thwaitesii*.

The caterpillars, when full-fed, are about $1\frac{1}{4}$ to 2 inches long, covered all over with long, erect, yellow hairs, a thick bunch of which occurs on the dorsal aspect of each of the first four segments of the abdomen, and also on the terminal segment; there is a black transverse stripe between the two anterior dorsal tufts.

After it is full-fed the caterpillar spins itself up between the leaves of its food-plant, into a scanty cocoon, composed of its own hairs, which appear to be very easily detached, and which it binds together with silk. After almost completely denuding itself of hairs to form the cocoon in which it encloses itself, the caterpillar creeps out of its larval skin and becomes a pupa. In the case of the February generation, which was the one that was kept under observation, the insect remained in the pupal state for rather less than a fortnight. The most noticeable feature about the moth is the difference between the sexes, the male being very much smaller and more brightly coloured than the female.

Mr. Moore describes the moth as follows:—

“*Male*: fore wing, greyish white, crossed by a basal, antemedial, and a post medial, indistinct, black speckled sinuous duplex line, and a marginal side line, a lunular mark at the end of the cell, the lines slightly dilated at the costal end; hind wing, pale brown, the costal border and the cilia, greyish-white; thorax, head, palpi and legs, greyish-white; abdomen, pale brown; thorax, slightly brown speckled; sides of head and palpi, blackish, legs with black spots; antennæ ochreous brown, shaft white.

“*Female*: fore wing greyish-white, irrorated with numerous brown scales, the transverse sinuous lines much less defined, being mostly apparent at the costal end and composed of scattered brown scales; hind wing white, with a few brown scales from

¹ Lepidoptera, Ceylon, Vol. II, p. 98.

the anal angle; body greyish-white; thorax brown speckled; legs and antennæ as in the male.

"*Expanse*—male $1\frac{1}{2}$ inches; female $2\frac{3}{4}$ inches."

Food-plants; Moore quotes from Thwaites that the larvæ feed on *Erythrina indica*, while from the above we learn that it also feeds on tea, sâl, and *Careya arborea*.

A considerable number of cocoons were sent to the Museum, but almost all of them were destroyed by parasites, of which the most numerous in individuals was a tachinid fly. The pupæ of the tachinid were found in great numbers loose in the bottom of the breeding cage, where the larvæ, after leaving the caterpillars in which they had developed, had no doubt been overtaken by their pupal stage, whilst endeavouring to hide themselves in the ground after the manner of the "silk worm fly" with which they appear to be identical. A few chalcid parasites also emerged, and these Mr. P. Cameron has kindly examined: he finds that they belong to two species, *viz.*, *Chalcis* (*Brachymeria*) *euplœa*, and a new species of *Perilampus*. Of these three species of parasites, the tachinid flies, no doubt, did by far the most execution; but the chalcids must have accounted for a certain number of the pest, and altogether the parasites were so effective that out of a very considerable number of cocoons of the pest, which the writer attempted to rear, it was with difficulty that sufficient moths could be obtained for the identification of the species. If, therefore, the specimens sent to the Museum were at all representative of those left on the bushes, but very few moths of the February generation will have emerged to propagate the species, and there can be little to fear from the pest next year.

Dasychira thwaitesii seems to be singularly subject to the attack of parasites, for Mr. Fisher's experience in 1878 with the sâl pest is almost identical with what has been above described, in the case of the tea pest.

Mr. Fisher writes: ¹—

"I collected several hundred chrysalids, intending to send specimens for identification, but they all died, whether from a disease or ichneumonisms I cannot now determine. Since May 1879 I have not noticed a single specimen of the insect."

He considers that the mortality amongst the chrysalids may possibly have been due to the unusual heat and dryness of the weather in March and April 1879, but the writer is inclined to think that *Dasychira thwaitesii*, like many other insects, is continually kept in check by internal parasites, which have such vast powers of reproduction that, whenever their favourite food becomes abundant they multiply to such extent as very rapidly to destroy the great majority of the insects on which they feed, though they may never succeed in entirely extirpating them.

The tachinid fly has not been described in this paper, as a considerable amount of information has been collected concerning it, and it would seem more appropriate to consider it in connection with the silk worm of which it is so serious a parasite.

The following is the synonymy, as given by Mr. P. Cameron, of *Chalcis euplœa*, the Hymenopterus parasite, with incrassated hind femora:—

“*Chalcis* (*Brachymeria*) *euplœa*, Westw., Proc. Ent. Soc. Lond., Vol. II, p. VI, Pl. II, figs. 9 and 10, (1837-40).

“*Chalcis lasus*, Walker, Ent. I, p. 219.

“*Chalcis inclinator*, Walker, Trans. Ent. Soc. Lond. (3), I, p. 355, (1862-64).

“*Chalcis obscurata*, Walker, Trans. Ent. Soc. Lond., 1874, p. 399. Exhibited by Hope at a meeting of the London Entomological Society as a parasite of a *Euplœa* butterfly from India.

“It is also recorded from Ceylon, Java, Aru, Borneo, Batchian, China and Japan.”

The following is a translation of Westwood's description of the insect:—

“*Chalcis* (*Brachymeria*) *euplœa*; Black, pubescent; thorax and head punctated, abdomen smooth; tegulæ yellow; the two anterior pairs of legs yellow, except the femora, which in the front legs are black at the base, and in the second pair of legs are black with yellow extremities; in the hind legs, the coxa, and trochanter are black the femur is black, with yellow on both sides of the extremity; the tibia is yellow except at the base where it is blackish; the tarsi are yellow, and the pulvillous yellow. The posterior femora are each armed, on the internal margin, with about ten minute teeth.”

From the descriptions given by Walker and Westwood, it appears that the length of the body varies from two to three lines, the expanse of the wings from $3\frac{1}{2}$ to 5 lines.

The second chalcid, which Mr. Cameron has determined as a new species of *Perilampus*, is figured in the plate, but has not yet been described.

If it should turn out, as now appears probable, that the tachinid which attacks the *Dasychira thwaitesii* is the same as the “fly” that destroys silk worms in Murshidabad and other parts of Bengal, it would seem to be well worth while to ascertain by actual experiment whether the increase of the pest cannot be more rapidly controlled by introducing fly-blown worms from the silk districts than by waiting for the parasites to be introduced by accident.

Besides any such possible method of controlling the pest, however, there can be no doubt but that, in any limited area, the caterpillars can be readily destroyed by arsenical insecticides,¹ though it has yet to be ascertained to what extent it will pay to employ these substances in India.

¹ See Notes on Economic Entomology, No. 2.

The fact, observed by Mr. Fisher, that vigorous trees are not attacked to the same extent as trees in an unhealthy condition, is worthy of notice as being another instance of what would seem to be a very general law with insect pests.

5.—CUT WORMS.

Agrotis suffusa, Hübn.

Plate III, fig. 2, a larva (nat. size), b larval head (enlarged), c moth (nat. size).

Injury to paddy from insects that are probably "Cut worms" has been reported from Balasore and Chittagong, while it is not improbable that much of the damage reported from other districts as due to obscure lepidopterous larvæ, may also have been done by insects belonging to this group.

The following abstract therefore is given of an account by Dr. Riley of the general habits of Cut Worms in America, together with his suggestion for dealing with them:—

"Cut Worms are Noctuid moths, generally belonging to the general *Agrotis*, *Hadena* and *Mamestra*. The larvæ are stout, naked worms of sombre colours, curling into a roll when disturbed and transforming to naked pupæ under ground. The moths fly only at night or in the dusk; they generally attach their eggs near the ground on twigs and branches of trees *away* from the food of the young larvæ, which have therefore to seek their food-plant when they hatch out. In their first larval stages the larvæ are much like loopers (*Geometrites*); at the approach of winter (in the North States of America) they are generally about half-grown and hibernate under stones and logs, or burrow beneath the surface of the ground. From these winter quarters they come forth on the approach of spring and do great injury to young and tender plants, not contenting themselves with feeding on leaves but cutting off the plants at their stems. Many feed by day, as well as by night, pulling leaves and sprouts into the underground burrows and there devouring them at their leisure. The pupal state, which is passed underground, lasts three or four weeks. Many of the species are one-brooded in the United States, but others have two broods. The larvæ are attacked by Tachinid and Ichneumon parasites."

The following has been found effectual by Dr. Riley for destroying Cut worms. Bundles of cabbage, turnip, or clover are sprinkled with Paris green water and laid at intervals between the rows of the crop to be protected, but, before the plants come up, these poison the Cut worms, which are thus got rid of before the appearance of the crop which they would otherwise attack.

Remedies.

In the Museum collection is a specimen of the Noctues moth *Agrotis suffusa*, bred by Mr. Wood-Mason in September 1887 from a caterpillar that was said to attack the winter crops, mustard and linseed, in the Jessore district.

This, a cosmopolitan insect, which has been recorded as occurring in all parts of India, besides Ceylon, Europe, America, Australia, New Zealand, Africa and China.

Dr. Riley, in Report of the United States *Entomologist* for 1884, page 294, describes it as *Agrotis ypsilon* or the "Greasy Cut Worm," having previously described it in the *Prairie Farmer*, June 2nd 1867, as the "Black Cut Worm;" and in the first report of the insects of Missouri, 1869, page 80, as *Agrotis telifera* of Harris, while the insect has been described in Europe by Van Rottenburg as *ypsilon*, and by Hübner as *suffusa*. Of all the names, however, by which this insect has been called, *Agrotis suffusa*¹ seems to be the best known, and it is therefore adopted here.

Dr. Riley writes² :—

"The larva has a most emphatic and pernicious cutting habit. We have known it cut off large tomato plants that were over six inches in height, generally at an inch above ground. After severing one plant, the same worm would travel to other plants, and thus, in a single night, would ruin three or four. In quite hard, clayey, corn-land, each worm was found to have a smooth burrow, in which it lay hidden during the day, and to the bottom of which it could generally be traced.

"Nothing seems to come amiss to its voracious appetite. It is reported as one of the species especially destructive to corn-fields and gardens. It destroys young tomato and tobacco plants, and, in confinement, feeds with equal relish on apple and grape leaves, and has been found in a garden cutting off cypress vines; it is also one of the cotton Cut worms of the south."

Dr. Riley notices that there are probably two generations of the insect in the year, and that there is great irregularity in the time of development and mode of hybernation :—

"The eggs are laid in small batches, and often in two or three layers, covered sparsely with long scales from the abdomen of the female moth. They are pale fulvous in colour, and nearly spherical in shape, the base being somewhat flattened. The polar ribs are not very distinct, and the crown is small. These eggs we have found laid on peach and sycamore leaves, upon which the larvæ do not feed. The larva in the first stage is also a semi-looper, the front prolegs being atrophied. The species is parasitized by tachinidæ, which we have often bred from it."

¹ See "Catalogue of the Moths of India," Cotes and Swinhoe, page 309, for further references to what has been written on this insect.

² Report of U. S. *Entomologist*, 1884, page 294.

³ Riley, *l. c.*

6.—THE CEDRELA TOONA MOTH.

Magiria robusta, Moore.

Plate III, fig. 3, a moth, b pupa, c larva; all natural size.

Specimens of this pest have been received from Mr. E. E. Green, of Ceylon, who writes that the larvæ damage *Cedrela toona* trees which are cultivated on the coffee estates for firewood and timber-supply.

Mr. Green writes¹ :—

“The larvæ appear to affect the new growth only, living on the succulent tops and devouring the pith of the stems and leaf stalks. The effect of the borer is to kill off the leading shoot, after which numerous adventitious shoots appear below the point of injury. The presence of the borer may be detected by the accumulation of the excreta at the mouth of the tunnel where they are fixed and woven together with silk by the larva.”

The following extract is taken from a paper² signed T. S. G. that appeared in the *Indian Forester* in 1876, and which appears to apply to the same species :—

“The insect almost yearly attacks the young shoots of the toon tree, boring its way along the pith which it seems to live upon, and leaving behind it an unsightly looking mass of transparent gummy exudation. The larvæ is white with black and yellow spots. It attacks trees both in plantations and in the forests, and prefers those about three feet in height and of strong growth. It seems to attack, however, more particularly those trees which grow in cleared land or near roads, while others growing close by, in grass or with other trees, have been comparatively unharmed.”

Some larvæ of this insect have been sent to the Museum by the Sub-divisional Officer of Alipur, Western Doonars, who found them in the wood of some young mahogany trees. In this case, however, it seems probable that most of the injury was done by some Coleopterous larvæ that were also found in considerable numbers.

Mr. Moore, in his *Lepidoptera of Ceylon*, Vol. III, p. 366, quotes from Thwaites that the larvæ feed within the branchlets of mahogany.

From the Director of the Forest School, Dehra Dun, have been received specimens of what appears to be the caterpillar of this moth, found by the Forest Ranger of Nilambur, Madras, “attacking the succulent branches of experimental mahogany plants.”

Caterpillars of this insect were also obtained from the Museum of the Forest School, Dehra Dun, where they were marked as having, in June 1886, proved destructive to the seeds³ of *Cedrela toona*.

Mr. Moore, in his *Lepidoptera of Ceylon*, classes the insect in the family Phycitidæ.

The following is his description :—

“Female. Fore wing, pale ochreous-brown, very thickly speckled with cinereous-white along the anterior border, and sparsely speckled with black scales along the

¹ Letter dated 7th January 1889.

² *Indian Forester*, Vol. I, p. 197 (1876).

³ This may possibly be a mistake.

posterior border; all the veins, excepting the submedian, lined with black, crossed by a discal, denticulated, whitish-speckled line; marginal points white; hind wing, ochreous-white, semi-hyaline, slightly opalescent, with a pale ochreous-brown slender marginal border; cilia white, with a brown inner line. Body, palpi and legs ochreous-brown; sides of collar, tegulæ, and base of abdomen with a cluster of black speckles; fore legs above dark-brown, with white bands; middle and hind legs whitish speckled a brown band on middle tibiæ, and whitish bands on the tarsi. Expanse of the female one and three-tenths of an inch."

"Pupa dark purple-brown, enclosed within an elongated slight silken cocoon attached to the stem of the food-plant."

Mr. Green describes the larva as follows:—

"Colour dull purple. Head black—second and thirteenth segments each with two black corneous dorsal plates. Other segments each with a transverse series of six raised black corneous spots, with a second row of two similar spots on each of the fifth to the twelfth segments. A small dull orange-coloured lateral spot on second and fifth to twelfth segments. Spins a compact whitish cocoon."

The larvæ reared by Mr. Green were full fed about the end of September, the moths appearing towards the end of October.

7.—CLOTHES MOTHS.

Specimens of a Clothes moth, and of blankets destroyed by it, were received in December 1887 from the Superintendent and Agent, Army Clothing, Alipore, with the information that they were taken from a bale of country blanketing which had been baled up and 'dammered' about two years previously, and which was found to be completely destroyed. It was also stated that it was impossible to open such bales periodically for brushing and beating.

Amongst the débris we found a few larvæ, mostly in the earlier stages of development, and a large number of empty, paper-like cocoons of a Tineid moth most nearly resembling Taschenberg's description (*Praktische insektenkunde*, Vol. III, 1880, p. 261) of *Tineola baseliella* Humm. which is known to attack woollen cloth, feathers, and such like.

Specimens of the moth were successfully reared in the Museum and forwarded to Europe for precise determination, but they have not yet been returned.

It was suggested that a little kerosine oil poured into the centre of a bale before closing it up would probably preserve it from attack, and that a weak solution of carbolic acid, spirits of turpentine, benzine, camphor, or naphthaline would also probably be effective, regard being had to their relative cost, and the offensiveness of the odour likely to remain in the articles composing the bale.

Since the above was written information ¹ has been received from Mr. Wood-Mason that naphthaline, which is largely used in this Museum as

¹ In a letter, dated 7th January 1889.

a preservative against insects, has been repeatedly supplied to the Army Clothing Department, both for clothes and also blankets, and that it appears to have proved a success. Fears were at first entertained that the naphthaline would tarnish gold lace, but Mr. Wood-Mason has found that this is not the case.

Specimens of Clothes Moth, a which is probably *Tinea tapetzella*, have been received from Mr. R. Chapman, with the information that they have done some damage to raw wool in the Economic section of this Museum.

Wool moth.

8.—THE BENGAL RICE HISPA.

Hispa ænescens, Baly.

Plate II, fig. 1, a (nat. size), b (enlarged).

This rice pest is widely distributed in India, and a number of reports have been received of damage done by it in different parts of Bengal. In the collections of the Indian Museum, there are specimens from Sikkim (Atkinson), Kullu (purchased), Chittagong (Director of Land Records and Agriculture, Bengal), Midnapore (Cotton), Calcutta (Lyall, also from the Collector, 24-Pergunnahs), Khulna (Rainey), Durbhunga (Duff), Hooghly (Collector of the 24-Pergunnahs), Behar (Moulvi Syed Nisah Ali, through the Director of Land Records and Agriculture, Bengal), South India (Father Honoré).

Distribution.

The insect is a beetle belonging to the family Chrysomelidæ, almost all the species of which feed on leaves, both in the larval state, and also after they have become beetles, by far the greater part of the damage, however, being done by the larvæ.

Zoological position of the insect.

From the reports that have been received, it seems that the pest appears often in vast numbers during the rains, when the rice has just been planted out and is still young and tender, the insects feeding on the parenchyma of the leaves and stalks, leaving the fibre exposed, so as to give the plants a white and withered appearance. The insect pupates on the plant.

Life history.

Details of the life history of this pest are at present wanting, but it may be inferred from the life history of other species of Chrysomelidæ, which have been carefully studied in America and Europe, that the history of *Hispa ænescens* is somewhat as follows:—

The eggs are probably deposited on the leaves of the rice immediately after it is planted out, the young larvæ quickly emerging and proceeding to devour the tender leaves, the pupæ being formed on the plant, and the perfect beetle emerging within a fortnight or three weeks of the eggs being deposited: so that the cycle of a generation may be gone

through in the course of three weeks or a month, and several generations may occur in the year, the beetles assisting the larvæ in their work of destruction and finally hybernating, in any neighbouring shelter, in this stage.

As yet the beetle is the only stage in the insect's life of which specimens have been received, but it is hoped that next year some of the contributors to these "Notes on Economic Entomology" may interest themselves in procuring specimens in other stages of development (egg, larva and pupa), and also in studying its life history. Some of the most important points to observe being,—the number of generations gone through by the insect while it remains on the rice; the manner in which it passes its existence in the interval between disappearing in the autumn and being again seen in the rains; and last, but not least, the methods which are likely to be effectual in combating it.

The effect of the pest would seem to be to stunt and weaken the plants and cause them to yield but a small crop. Damage done by the pest. The rice is apparently in no case completely destroyed by the insect, but the outturn may be reduced by from twelve to fifty per cent.

No very definite information has yet been received with regard to remedies: the only two that are mentioned as adopted by the cultivators, being the smoking the insects out of the field, and the letting out of the water.

With regard to the first of these remedies, Mr. F. W. Higgins, of Chittagong, writes¹ :—

"On my bearer informing me of its (*i.e.*, *Burmah chaudali*) having attacked his paddy, I advised him to try smoking them out, and he reported its having acted like a charm; in half an hour all had cleared off from the paddy. About four kamis were attacked out of ten kamis planted. The *modus operandi* was as follows:—Fires of paddy-straw, covered over with green leaves to increase the smoke, were placed about the field at about 30 to 40 feet apart (a calm day was selected). When the smoke had spread about a little, four men with torches of lighted paddy-straw, twisted up and slightly damped on the outside to increase the smoke, went through the paddy, shaking off the bugs and moving the smoking mass amongst the corn. The bugs cleared out entirely, but I cannot guarantee their having been destroyed."

The smoking operation does not seem to have been tried elsewhere on this pest, and as smoke has been found to be altogether ineffectual against other insect pests on which it has been tried, the writer is inclined to think that reliance should not be placed in the remedy until it has been more definitely tested.

With regard to the letting out of the water from the rice fields, as a remedy for the pest, mentioned in a report² by the Deputy Collector

¹ In a letter to the Collector of Chittagong, forwarded by the Director of Land Records and Agriculture, Bengal. See page 40.

² Forwarded by the Collector of the 24-Pergunnahs.

of Basirhat, this would appear to be more promising, though it would obviously be only possible to adopt it in certain cases. In this connection the Deputy Collector of Basirhat notices that only rice which is almost completely submerged is attacked, the attack lasting only so long as the water remains in the field, and the rice which grows where there is but little water being exempt.

Arsenical washes, such as London purple and Paris green, have been found useful in America for destroying the elm leaf beetle, which belongs to the same family as *Hispa ænescens*, and these preparations would no doubt be equally effective in destroying the Rice Hispa, but the cost of their application would seem likely to be prohibitive.

The following description of the beetle by Mr. Jacob S. Baly was published in the Journal, Asiatic Society of Bengal, Volume LV, Part II, page 412 (1886).

“*Subelongata, nitida, subtus cum antennis nigra, pedibus nigro-æneo micantibus; supra nigro-æneo aut nigro-cuprea; thorace rugoso-punctato, lateribus ante medium spinis quatuor, basi connatis et pone medium spinâ unicâ armatis; elytris anguste oblongis, fortiter seriato-punctatis, spinis validis triseriatim dispositis, instructis. Long. 2 lin.*

Hispa ænescens.

“HAB. Chittagong District.

“Antennæ slender, very slightly thickened towards the apex, the basal joint armed at its apex beneath with a short tooth; vertex finely rugulose, longitudinally sulcate. Thorax rather broader than long, subcylindrical, flattened on the disk; sides armed before the middle with four stout spines, united into a single stem at their base, the anterior spine looking almost directly upwards, the three others obliquely upwards and outwards; behind the middle is also a single spine, looking outwards and slightly upwards, hinder angle armed with a short subacute tooth; disk coarsely rugose-punctate, a longitudinal vitta and a slightly concave space on either side behind the middle nearly free from punctures. Scutellum smooth, impunctate. Elytra narrowly oblong, strongly seriate-punctate, armed with a number of strong erect spines, arranged in three longitudinal rows, those on the outer row more crowded than those on the disk. Legs simple.

“The small tooth at the lower edge of the apex of the basal joints of the antennæ, and the absence of any spines on the upper surface of the joints, together with the colour of the upper surface of the body, will separate the above species from any others known to me.”

CORRESPONDENCE CONCERNING THE RICE HISPA.

The Collector of Chittagong writes:—

“During a tour in the district lately, I came across fields of aus dhan which had been destroyed by insects. In fact, the greater part of the aus crops in many mouzahs of this district had been thus destroyed. The insects attack the young dhan. It then withers and dies away, presenting the appearance as if it had been eaten up by goats or cows.

“I found that the aus dhan was attacked by two kinds of insects, one is known locally as the *Burmah chaudali*; it is a small black beetle.”²

¹ In a letter dated 30th September 1886, which was forwarded by the Director of Land Records and Agriculture, Bengal.

² Specimens were sent, which proved to be *Hispa ænescens*.

"My attention was first drawn to these insects, and the ravages they made amongst the aus dhan, by Mr. F. W. Higgins, of Patya, a tea-planter of this district. The following is an extract from a letter on the subject written by that gentleman the other day to me. He writes chiefly about the *Burmah chauli*."

Here follows the extract quoted on page 38.

Mr. J. R. Rainey of Khulna notes¹ that the local native name of the insect is "*Paruli*." He writes that it is "very destructive to the leaves of the paddy crop when the plant is young and tender." The rice stalks which he sends have the parenchyma of the leaves eaten away in patches, so as to make them look brown and withered.

Mr. Patrick Duff writes²:—

"I kept a few insects which did a great deal of harm this year to the dhan, but more particularly to the *ropa*, or transplanted paddy. They appeared late in June, and were very plentiful in July and the beginning of August. I send you a small box containing all the specimens I kept. Neither sun nor rain seemed to diminish their numbers. They are said to have been seen once before 16 or 17 years ago; some persons called them '*Kal*' and others '*Mudhwa*.' They devoured the tender case of the dhan and laid their eggs in the upper leaves, apparently inserting the egg under the outer fibre of the leaves; or perhaps the growing insects forced their way under the leaves, splitting them in two and staying inside until perfect. The ones I send were in the chrysalis state when I took them out of the leaves, and I placed them in a pill box. The effect of the ravages was only to temporarily check the growth of the dhan. It is now looking well again. One peculiarity I noticed was that the insects always attacked the western edge of the fields and worked eastwards. They were literally in millions in every field."

Baboo Doorga Churn Law, of Hooghly, notes that the insect is called *Sanki*:— he writes³: "Small circular insects of black color; three or four of these enter the stalk and cut it. It is very destructive to paddy and remains long in the field."

Baboo Nobin Krishna Banerji of Diamond Harbour writes:⁴ "*Paruli* insects are not available this year in consequence of flood. The ryots cannot give any information as to how these insects are bred."

Mr. F. J. S. Maguire writes⁵:—

"The sub-divisional officer of Bagirhat, and the Naib of Chandkhali (a Government estate), report that it does not appear that there has been any occurrence of insect pests. Both these officers report that *Pavali poka* damages to a certain extent the rice crop. Damage is done by them both at the time of transplantation and at the time when the rice is about to be reaped."

¹ In a letter dated 12th July.

² In a letter dated 6th September from Bhuptiabe, forwarded by the Magistrate of Durbhanga.

³ In a letter dated 26th September 1888, forwarded by the Collector of the 24-Pergunnahs.

⁴ In a letter dated 1st October, forwarded by the Collector of the 24-Pergunnahs.

⁵ In a letter dated 25th September, forwarded by the Director of Land Records and Agriculture, Bengal.

Baboo Mohendra Nath Bose writes ¹ of *Hispa ænescens* that it is called *Pâmâri*—“These insects always exist in the paddy fields, and probably grow in earth, when in the middle of the month of Aswin, corresponding to the months of September and October, western winds blow very hard, these insects fly out in the air in innumerable number and destroy the paddy plants.”

The Sub-Manager of the Raj, Darbhunga, wrote ² of *Hispa ænescens* on 11th October—“A peculiar kind of black insect that has been eating away wholesale the green leaves of the paddy in almost all the villages in my circle. The ryots say that they never saw such insect pests before.”

On 31st October the Manager of the Raj, Darbhunga, wrote ³: “These pests have now nearly disappeared.”

The following is an abstract of a report ⁴ by the Deputy Collector of Basirhat:—“*Shanki poka*, or ‘the Whitening Insect,’ is a small, black, fly-like insect which damages the young paddy plants, and especially of *amun* rice. The insect eats off the green covering of the leaves, leaving the fibre intact, which gives the paddy a white and withered appearance. The young plants are weakened and stunted in growth by the attack, and consequently yield from twelve to fifty per cent. less than they otherwise would do, but the crop is never totally destroyed. The pest is first noticed in June or July when it appears in such vast numbers as sometimes to blacken square miles of rice fields. It attacks the seedlings which have only just taken root after transplantation, and of these only such as are almost completely submerged in the water, paddy which stands on ground where there is but little water being exempt; again, for seedlings to be attacked, they must be in the first stage of their growth, when the leaves are young and tender, before they become rough and hard and their edges become sharp, as in the second stage of growth when the pest is unable to harm them. The pest selects, in the first instance, the fresh green shoots, and, after eating these, it attacks such of the older leaves as are still somewhat soft and, thin; in the case of the older leaves, however, it only eats the parenchyma, leaving the fibre exposed; the pest also devours each fresh blade as it is put forth.

“The attack lasts as long as the water remains in the field, the insects disappearing altogether for the season as soon as the water subsides sufficiently to expose the paddy stalks.

“The only thing ever done by the cultivators to fight the pest is to let the water out of the field, and this of course can only be effected in some cases.

“A curious superstition prevails with regard to the insect, and is entirely believed in by the cultivators. The notion being that the surest way to get rid of the pest, is for a man or boy who has been born in the month of Bhadro, to walk over the field and stick a leaf of a date tree in some part of it, then to pinch off the heads of some of the insects and bury the headless bodies in the field. The superstition has so strong a hold on the minds of the cultivators that whenever the pest appears they invariably (and sometimes at great expense) seek out a Bhadro-born man or boy and get them to perform the ceremony. This pest is said to occur more frequently than the jute pest, but no ⁵ specimens could be found for the Deputy Collector of Basirhat to forward.

¹ In a letter dated Calcutta, 2nd September 1888, forwarded by the Collector of 24-Pergunnahs.

² In a letter dated 11th October, forwarded by the Magistrate of Durbhanga.

³ In a letter dated 31st October, forwarded by the Magistrate of Durbhanga.

⁴ Dated 5th November, and forwarded by the Collector of the 24-Pergunnahs.

⁵ Specimens of *Hispa ænescens* from the Museum, however, were sent to the Deputy Collector of Basirhat, who identified them as the “*Shanki poka*.”

9. THE MAKAI TREE BARK BORER.

Tomicus sp.

Specimens of a Scolytid beetle, reported by the Officiating Deputy Conservator of Forests, Sibsagar, Assam, to be injurious to the Makai tree, *Shorea assamica*, have been received through the Director of the Forest School, Dehra Dun.

The insect proves on examination to be a bark beetle belonging to the genus *Tomicus* (family Scolytidæ). It has not been found possible to determine it with absolute certainty in this Museum, and specimens have therefore been sent to Europe for comparison :¹ the insect, however, corresponds very closely to the description of *Tomicus chalcographus* of Linnæus, an insect recorded as injurious to *Abies excelsa* and other trees throughout the whole of Europe and also in America.² An excellent description of the insect is given in Eichhoff's "Europäischen Borkenkäfer"—Berlin, 1881, p. 249 ; his remarks, however, are not given here in full, as the identity of the insect has not yet been fully established.

In this group of insects the female beetle bores its way into the bark, thus making a tunnel, along the sides of which it deposits its eggs. The grubs on emerging from the eggs, each tunnels on its own account from the place where its egg-shell lay, becomes full-fed, and transforms into a pupa in the barrow, emerging as a beetle which copulates and lays its eggs. The beetle is known to prefer for its attack, trees whose vitality is impaired, and in which therefore the flow of sap is not very strong. Eichhoff has observed, in the case of *Tomicus curvidens* (and he believes it to be also the case with *T. chalcographus*), that, when it is unable to find damaged trees, it attacks healthy ones, tunnelling in great numbers into them and thus lowering their vitality and making them suitable for the nourishment of the species. It is true that the flow of sap in the tree may be too strong for the eggs of the actual beetles that first attack it to come to anything, but the tree is so injured that it falls an easy prey to succeeding generations of the pest which emerge from other trees which are in a more advanced stage of the attack.

Eichhoff has observed in Germany that the beetles emerge in great numbers in April or May ; copulate and lay their eggs, which become fully developed in the end of June or in July, when the second generation of beetles emerges to copulate and lay eggs, becoming fully developed in the autumn and emerging the following April or May. There are thus two complete generations gone through by the insect in Europe,

¹ Specimens of this insect were submitted to Dr. Günther, who had kindly undertaken to have them examined. He has since reported on them as belonging to a species of *Tomicus*, which is unnamed in the collections of the British Museum.

² For an account of the insect in America, see Packard, U. S. Ent. Commission, Bull. No. 7, 1881, p. 166.

and it is probable that, with increased warmth, this number may be exceeded in India.

From the habits of the insect, preventive measures have been devised which Eichhoff recommends very strongly, and which have certainly been adopted in some parts of Germany, though it remains to be seen to what extent they are applicable in India.

The following are the measures which Eichhoff recommends (see his *Europäischen Borkenkäfer*, p. 228).

All damaged and unhealthy trees should be, as far as possible, removed or barked, as it is in these that the beetle chiefly breeds. Unbarked trees should not be allowed to lie about in the forest. Traps should be prepared periodically for the insects, at the times that the insects are known to be on the wing, by felling or ringing a certain number of trees, and leaving them in a withering condition in the forest during the two or three weeks the insects are about. Most attractive food will thus be provided for the beetles, which will lay their eggs in vast numbers in the prepared trees and spare the healthy ones, which they would otherwise attack. After the prepared trees have remained for three or four weeks in a withering condition in the forest, they should be carefully barked, and the bark and branches burnt, so as to destroy the grubs of the bark beetles, which would otherwise emerge as beetles about two months after the eggs had been laid.

The beetles sent to the Museum were forwarded from Assam on the 4th of April last year; it may therefore be presumed that about that date, or shortly afterwards, they would have emerged, and have commenced laying their eggs. The end of March would therefore be the time to prepare trees to entrap the first generation of the insect, while the following generations might be expected to emerge respectively in June, August and October; about the number and dates of emergence of the respective generations, however, no information has been obtained.

It would be well worth, in observing the general life history of the insect in India, to direct particular attention to the number of generations in the year, and the dates of their respective emergence; and, having done this, to ascertain by careful experiment whether or not Eichhoff's recommendations are likely to be of service.

10. BAMBOO INSECT.

Mr. G. Anderson, of Munzerabad, Mysore, sends pieces of jungle wood¹ attacked by an insect locally known as "Cootee."² He writes:—

"This class destroys bamboos, watties (basket-reeds), and many jungle woods. The natives have a superstition that no jungle poles or bamboos should be cut when the moon is full, as they argue that the sap is then very abundant, and unless the

¹ "Probably *Erinocarpus nimmoanus*." See his letter dated Barguai, 21st April 1888.

² A Canarese word, *ibid*.

bamboos are well soaked in a tank and subsequently preserved with plenty of smoke they will be rapidly destroyed by the *cootee* and other borers. The advice is excellent and should be invariably adopted, but it would be interesting to know what actual effect the moon has on the motion of the sap in growing trees. These insects also attack the pod, or capsule, of cardamoms, and, I think, are propagated in the forest rubbish; but the fact that I have found the insect in the larval and perfect state inside the capsule, suggests the probability that the female punctures the outer skin, lays its eggs therein, and the grubs, having passed the pupal stage, emerge as perfect beetles by the small round hole, leaving the cardamoms perfectly empty. 'Cotee' also attacks horse and cow-gram (*Dolichos inflorus* and *lablab*) and will utterly destroy solah pith hats, bread, baskets, mats, &c."

The insects which Mr. Anderson sends belong to a species of Bostrychidæ Beetles (Apatides), which, however, it has not been possible to identify precisely in Calcutta; specimens have therefore been sent to Europe for comparison.¹ It may be observed that all the substances which Mr. Anderson mentions, are not likely to be attacked by the same species, though they may be attacked by species which are very nearly allied to each other. The idea which prevails with regard to the effect of the moon is a curious one, and would really seem to have some foundation of fact to rest upon, the writer having been told that it prevails generally, both in Behar and also in the North-West. About the only explanation that has been put forward is to the effect that the 'cootee,' like most other wood-boring insects, prefers to lay its eggs in wood which has commenced to wither, and which consequently has no longer a healthy flow of sap to interfere with the insect in its burrow, though still full of nutritive juices on which the insect feeds. If this is the case, the time immediately after the bamboo has been cut down would be the most likely one for it to be attacked; and moonlight nights would give the insect a quiet time, with plenty of light, for finding the bamboos and ovipositing in them. This explanation, however, is little more than a guess and requires confirmation.

It seems to be the generally received idea that soaking bamboos, and also other timber, in water, for a considerable time, immediately after it has been felled, makes it less liable, than it otherwise would be, to suffer from boring beetles of all kinds. It is supposed that not only does the water prevent the beetles laying their eggs during the time the wood is immersed in it, but that it also drowns the larvæ already at work, and dissolves much of the nutritive matter on which they would otherwise feed.

It is notorious that bamboos suffer very considerably from the attack of small boring Bostrychid (Apatid) beetles. The writer has found

¹ Specimens of this insect were submitted to Dr. Günther, who had kindly undertaken to have them examined. He has since reported on them as belonging to a species of *Sinoxylon* which is unnamed in the collections of the British Museum. He also reports on a second species that was obtained by Mr. R. D. Oldham, in Dehra Dun, from a tent pole, which it had completely destroyed, as belonging to a species of *Dinoderus*, not in the British Museum collection.

that sponging the bamboo over with kerosine, in sufficient quantity to penetrate into their burrows, destroys the insects effectively and prevents further damage. This treatment, however, is obviously only applicable in a limited number of cases.

11. THE MANGO WEEVIL.

(*Cryptorhynchus mangifera*).

Plate IV, fig. 1, a larva, b pupa, c imago (dorsal view), d imago, ventral view: all enlarged.

An Extract.¹

The mango weevil would be classified as follows:—Order *Coleoptera*; family *Curculionidæ*; genus *Cryptorhynchus*; species *mangifera* (of Fabricius). The specimen from which my slides were taken was a little over $\frac{1}{4}$ of an inch in length, and about $\frac{1}{8}$ of an inch in breadth; and to ensure identity, was taken by me fresh from the heart of the fruit. Almost black when first removed from the mango, on being dried it assumed a lighter, rusty-brown hue. The head of the weevil is produced into a rostrum, with ten jointed antennæ on its sides, which are elbowed beyond the long scape, and terminate in a knob.

The elytra are very convex, and extremely hard; and, together with the rostrum and feet, are covered with scales of a light yellowish colour; these scales are not brilliant.

The larvæ answer the general description of larvæ in the weevil family; they were white, "thick, fleshy, footless grubs, with fleshy tubercles instead of legs" (Packard, p. 484), and while there were three or four of them together in one mango, I have not found more than one pupa, or one perfect insect in any single fruit. The larval and pupa stages are passed, and the imago form attained in the fruit itself; and the period of pupation would seem to be short, seeing the larvæ were obtained from a ripe mango.

The geographical range of the pest under consideration is extensive. It is found in the Isle of France and in Madagascar, and it would be interesting to learn something about its ravages, and to ascertain when it was first observed, how supposed to be introduced, &c., in the islands named. It does not yet affect all the mango-producing districts of India, but its march is progressive. Restricted apparently at one time to Dacca and the South-Eastern districts, Backergunge, Furridpore, &c., I learn it is working its way westward and northward, and throughout Bengal and the neighbouring districts. An article on the subject will be found at page 558 of *Reis and Rayyet* for 1885, in which we are told that this insect-pest has invaded the Presidency, and that in the season

¹ Taken from a paper by Mr. W. J. Simmons in the Journal of the Agricultural and Horticultural Society of India, Volume VIII, Part II, new series.

of 1885 it showed itself in the well-kept orchard of Kaly Kissen Tagore. I learn from a gentleman residing in Ballygunge that every tree in his garden is infected. *Reis and Rayyet* also informs us that Sylhet was formerly practically free from this curculio, two or three mangoes per 1,000 alone being tainted. During the last few years the pest has gained ground so rapidly in Sylhet that now not a single tree nor fruit is free. According to Tayler's *Thirty-eight Years in India* (Volume II, page 331) the mango is the staple fruit of India, and millions almost subsist on it during the season. Roxburgh says that in times of great scarcity and famine, the kernels are boiled in the steam of water and eaten. When you remember, from your own personal observation, how largely the mango enters into the dietary of the poorer classes, you will readily realize that the depredations of the weevil which attacks it are a serious matter.

I expect the egg of the weevil is deposited either in the flower, or in the very young fruit. During the last mango season—which, by the way, was not prolific in weevils—I examined several specimens of the fruit with the view of ascertaining what external indication they bore of the existence of the insect within, and I failed to “see it from the outside,” as one of the papers I have referred to says it can be seen. In almost every case examined by me, the weevil was about one-third off from the further end of the drupe, while there were no indications of its having worked its way from the surface, or the stem, through the pulp, to the cell. The cells were usually filled with brownish granules which I took to be the excreta of the insect.

The insect is found in the adult phase of its existence in the months of May, June, and July. The mango tree blossoms at the close of the cold season. Unless, therefore, there are two broods of the curculio, which is not likely to be the case, the pest must live through the drenching rains of the rainy season, and the low temperature prevailing in the cold months; and whether it attacks the flower, or the young fruit, it must be in a fit condition when the mango trees blossom, or their young fruits form, to deposit its ova. Now, we know that many insects pass from one season to another in a state of hybernation. They may hibernate in either the larva, or the pupa, or the adult state; or again they may lie over in the egg. I doubt very much if the eggs of the mango curculio are laid in the season previous to their being hatched; I think it probable that the *imago*, or adult weevil, lives over from one season to the next, and that in the interval it hides away in crevices under the bark, or in rubbish, or the like. In this connection, it is perhaps of some importance to note that if it hibernates in the localities I have suggested, then the dingy colour of this curculio is distinctly protective. Anyhow all these are matters which can only be verified by actual observation.

12.—DERMESTES VULPINUS, FABR.¹

Plate IV, fig. 2, a larva (dorsal view), b larva (side view), c pupa, d imago; all enlarged; fig. 2, e imago (nat. size).

Some specimens of *Dermestes vulpinus*, the leather beetle of America, have recently been sent to the Indian Museum by Mr. J. Cleghorn, of Rajshahye, who says that the larvæ attack eggs, worms, chrysalids and moths of the mulberry silkworm. During the rains cocoons having often to be reeled off, on account of damage done by this insect, within a fortnight of having been received, instead of being allowed to ripen as in the hot weather. The cocoons are thereby depreciated in value, sometimes to the extent of R12 per maund. Mr. Cleghorn has observed that the insects are most abundant during the rains, their numbers diminishing during the months between October and May, though causing loss of produce even during these months. He has seen the beetles flying at dusk into the house, and making straight for where cocoons are stored, selecting, in the first instance, ones that contain putrefying chrysalids, but also attacking sound ones; he has also found large numbers of the beetles drowned in water containing putrid matter.

The larvæ work their way readily through the substance of the silk cocoon to get at the enclosed chrysalid which they devour, and appear to thrive indifferently on any animal matter, having taken with much relish to a series of dead insects with which they have been fed in the Museum.

In the Indian Museum collections are imagos of this species from the Hazaribagh district (Wood-Mason), where they are said to attack stored tusser cocoons, also from Calcutta, Madras (Elliot), Naga Hills (Godwin-Austen), Deccan (Sykes), Bhutan (Pemberton), Muscat (Blanford), Nicobar Islands (de Roepstorff), South Australia (Wilson) New Zealand (Brown). The insect is, in fact, cosmopolitan.

The following notes on the history of the insect in other places are appended, in the hope that they may provoke discussion, and lead to the publication of suggestions by practical men for dealing with it as an enemy to the silk industry out here.

So long ago as 1839 Westwood, in his *Modern Classification of Insects*, wrote that *Dermestes vulpinus* occurred throughout Europe and America, and also in Java; that it had at one time done so much damage in skin warehouses in London that a reward of £20,000 was offered for an available remedy, without, however, any being discovered, and that an entire cargo of cork had been destroyed by it, the insects also damaging the timbers of the ship.

¹ This note was originally published in the "*Asian*." The figures are copied from Dr. Riley's plate in the Report of the Entomologist to the United States Department of Agriculture, for the year 1885.

This insect has recently been noticed in America owing to the damage it has done to stored boots and shoes, and its history has there been investigated by Miss Murtfeldt and Dr. C. H. Riley, from the latter of whose account, published in the Report of the U. S. Department of Agriculture for 1885, the following particulars have been taken :—

“The insect was first noticed in the establishment of a wholesale manufacturer of boots and shoes in Saint Louis in 1884, when a lot of boots and shoes were returned condemned as ‘wormy;’ about the same time the insects were found in numerous leather houses throughout the city and invaded the manufactories, where they retained their partiality for undressed leathers. The work of the larvæ, both old and young, in boots and shoes, consists in boring round smooth channels in every direction through the leather, preferring the soles and heels, though the uppers do not entirely escape.

“The adult beetle is principally occupied in the propagation of its species, yet is also a leather-destroyer, gnawing and scoring the surface of the boot, but not burrowing bodily into substance. The female has been observed to lay some score of nearly cylindrical eggs, each about two millimetres long, pure white, highly polished, slightly larger at one end than the other. The newly hatched larvæ are almost white in color, are covered with long hairs and are quite active, in a few hours acquiring the normal brownish-grey color and burying themselves in their food; they crawl with considerable rapidity, mounting smooth surfaces with ease; they moult six times, at intervals of about a week. The full grown larvæ is a thick hairy brown grub, about 13 millimetres long and one-fourth as broad; it tapers somewhat from the thorax to the anal end, which is bluntly pointed and armed with a pair of thorn-like projections. There is a longitudinal stripe down the back, and the six legs are of a reddish-brown color; with these it crawls rapidly with a quick darting motion, dragging the hind body on the surface over which it is passing. The pupa is sometimes found in the larval burrow, but more often the full grown larva leaves the leather and seeks for a crack in the box or floor, often burrowing for its length into the solid wood. In the warehouses where the goods are boxed up in soft wood, the boards are often riddled by these burrows, made by the larvæ seeking for safe places for pupation—this instinct of self-preservation being very necessary, as the larvæ have a fondness for the soft helpless pupæ of their own species, even when other and more natural food abounds. The beetle varies from eight mm. to twelve mm. in length. It presents, on the upper surface, a rather uniform brownish or greyish black appearance, the general color varying somewhat, according to maturity. In the more perfect specimens the dorsal surface is clothed with a very short pale, yellowish and rufous pubescence. The head and a broad band on each side of the thorax are more thickly covered with denser and longer silver-white hairs, while the ventral surface is closely covered with silvery-white pulvescence. Dr. Riley is of opinion that, while the whole of the stages of the insect, from the deposition of the egg to the emergence of the perfect insects may, under favorable circumstances, be gone through in a few weeks, under unfavorable conditions of food and temperature they may extend even to years.

“Where this insect has already effected an entrance, it would, according to Dr. Riley be preferable to overhaul the contents of the box and to treat what is found to be affected with benzine or other insecticide, but where this cannot be done without too great expense, it will probably suffice to open each case and place an open saucer of bisulphide of carbon on top of the contents. The liquid will volatilize, and the vapor will sink down through the mass, if the box be tight, and will kill the insects in their burrows.

“A preventive will, however, be of greater importance than a remedy in this case, and consists in clearing up and burning all clippings, scraps of leather and other refuse that accumulate and become breeding-places for the insect, examining and poisoning hides as soon as they arrive, and frequently examining the stock on hand when there is reason to suspect the presence of the beetle.”

13.—FURTHER NOTES ON INSECTICIDES.

Plate IV, fig. 3, force pump; fig. 4, a ordinary cyclone nozzle, b and c Vermorel modification of cyclone nozzle.

A valuable paper on the "Green Scale Bug" (*Lecanium viride*), which has of late years done serious injury to coffee cultivation in Southern India and Ceylon Coffee. was published in 1886 by Mr. Ernest Green, who described the remedies that had up to that time been proposed. With regard to these remedies, however, Mr. Green writes:—

"In some cases their application is quite impracticable; in many others, whatever may have been the result with the old bug,¹ they have absolutely no effect upon the new Green Bug."

In fact, up to that time, no satisfactory remedy for the pest had been found. As, however, the insect, which attacks orange trees in Florida, is closely allied to the Indian Coffee bug, it appeared probable that the kerosine emulsions which are being used successfully in Florida against the Orange insect² would prove equally applicable to the Coffee Scale in India.

In a paper,³ therefore, which was published in the Journal of the Agricultural and Horticultural Society of India, kerosine emulsion was suggested for experiment against Coffee Scale.

Results seem to show that the surmise was correct, and Mr. R. H. Morris writes⁴:—

"I have tried with great success an emulsion of kerosine made with common soap on the Green Bug, which has lately attacked coffee estates in the Nilgiris. One part of the emulsion diluted with nine parts of water, and sprayed over the affected coffee trees, kills the bug, whenever it touches, at the first application."

The chief difficulty appeared to be to obtain the proper apparatus for spraying the bushes with the insecticide, as the spray given by ordinary garden syringes was found to be far too coarse. Several American firms, however, who manufacture apparatus for distributing insecticides, are now sending their force pumps, &c., to the Indian Museum for experiment; while amongst the many practical Entomologists in different parts of India, who are in correspondence with the Museum, it is anticipated that there will be no difficulty in getting the necessary experiments conducted in order to ascertain which of these machines is best suited to the purpose.

¹ *Lecanium nigrum*.

² See Notes on Economic Entomology, No. 2, p. 5.

³ On the work of the United States Entomological Commission, by E. C. Cotes, Journ. Agri.-Horti. Soc. Ind., Vol. VIII, Part II, new series.

⁴ In a letter dated 16th July 1888.

In this connection the following remarks¹ by Professor Riley, the United States Agricultural Entomologist, are of interest :—

“There is no large firm in this country which makes a business of handling the various insecticides and machinery, but the trade is divided between some dozen or more principal firms who handle principally goods of their own special makes under proprietary marks or letters patent.

“The cyclone nozzle is manufactured by several firms in this country (it is not patented) also by firms in France and Australia. Thos. Sommerville and Sons, of this city, make the ordinary form at 5 dollars per dozen, and the Vermorel modification at 18 dollars per dozen. This latter style has a degorging rod, and is especially adapted to spraying heavy liquids, as lime-water for fungicide purposes. A wood-cut of this nozzle, entire, and in section, is enclosed (Pl. IV, fig. 4, *b*, *c*); V. Vermorel, Villefranche sur Rhone, France, is the manufacturer in Europe; Kutzner Bros., Masterton, New Zealand, manufacture a single and triplet cyclone; these we have not seen.

“Of pumps we use almost exclusively those made after the style known as the aquapult (pl. IV, fig. 3), the essential feature of which is a piston cylinder in a large outer cylinder, and of such relative dimensions that the downward stroke displaces as much water as the upward stroke lifts, thus securing constant pressure in what is practically a single cylinder pump. The size of the pump must be in accordance with the amount of work desired to be accomplished.

“Paris green and London purple are the only preparations of arsenic in general use here. The former can be supplied readily by any manufacturing chemist, and the latter is controlled entirely by Hemingway and Co., of London and New York City.”

An aquapult force pump of the kind recommended by Professor Riley has been received from Messrs. Woodin and Little, of 509, Market Street, San Francisco, U. S. The pump gives a very finely divided spray, but it is impossible to speak definitely as to its merits until it has been tried in the field. It is proposed to have it experimented with, for applying kerosine emulsion to destroy Coffee Scale in South India.

Force pumps have been received from Messrs. Rumsey & Co., of Seneca Falls, New York; they have not yet been experimented with, but appear to be suitable for applying washes, such as London purple and Paris green.

A supply of London purple from Messrs. Hemingway & Co., of 60, Mark Lane, E. C., London, has also been received for experiment.

14.—SHORT NOTES ON MISCELLANEOUS INSECT PESTS.

Lepidoptera.

In the Museum collections is a specimen of the Noctues moth *Heliothis armigera*, ticketed as having done injury to the Bollworm. the poppy crop in Patna in March 1879; there is also a half-eaten poppy-seed capsule apparently eaten by this worm, which is ticketed as having been damaged by an insect known as *kujra*; that is also injurious to potatoe.

¹ Extracted from a letter dated Washington, 29th May 1888.

In March 1887 specimens of *Heliothis armigera* were received from Arrah, where the insect was said to be injurious to poppy. 1887 some caterpillars, doubtfully¹ referred to this species, were received from Mr. J. Cameron, of Bangalore, who writes that they live chiefly on pulse crops, and especially on *Dolichos lablab*. A single caterpillar, also doubtfully referred to this species, was received in January 1888 from Mr. R. Rainey, of Kulna, who reported the insect as having been injurious to paddy. The Museum contains specimen of the moth which have been obtained from several localities in India, and the species has been recorded² as occurring in Ceylon, Europe, Africa, America, Jamaica and New Zealand.

In America it is known as the "Bollworm," and has proved most destructive to cotton, Indian corn, leguminosæ, and many other plants. A most complete account of it was given by Dr. Riley in the fourth report of the United States Entomological Commission, p. 354 (1885). In the case of the American insect, Dr. Riley notices that the eggs are deposited all over the cotton plant, the larvæ pupating in the ground and generally hybernating in the pupa state, though generation after generation is produced until the approach of the cold weather. Dr. Riley recommends autumn ploughing for destroying the pupæ, in countries where there is frost; the destruction of the moths by poisoned sweets and lantern traps; the destruction of the early broods of larvæ, in the restricted areas where they first appear, by hand-picking, or better by *Pyrethrum*; also the encouragement of insectivorous birds and poultry.

Some specimens of the Noctuid moth *Leucania loreyi* were received in September 1888, from the Commissioner of Settlements and Agriculture, Central Provinces, with the information that the caterpillar, which is known as *haripok*, has been doing great damage to the rice crop in the Sambalpur district, being reported to have caused a loss of about one-eighth of the crop in some places.

This insect is allied to the cut worms (see p. 33), and has been reported from several parts of Northern India, as well as from Europe, but no details of its life history seem to have been yet recorded in India.

Specimens of the larvæ of a Psychid moth, which could not be determined precisely in the absence of the imago, were received in June 1888 from Mr. O. C. V. Johnson of Daladere, Ranchi, with the information that they appear chiefly in November, and infest tea, sâl, and other plants: hand-picking, when the insects appear, being adopted for clearing the tea bushes of the pest.

¹ Mr. Cameron promises to try and rear the moth so that the identity of the South Indian pest may be precisely determined.

² See "Catalogue of the Moths of India," Cotes and Swinhoe, p. 271.

This insect does not seem to have been previously sent to the Museum as a pest, but an allied species, *Eumeta crameri*,¹ whose caterpillar builds its case of sticks (instead of the leaves in which the Ranchi insect shelters itself), has long been known as injurious to tea in Darjeeling, where also hand-picking is the treatment adopted.

It is well known that with Psychidæ, each caterpillar builds a case for itself of silk and leaves or sticks, enlarging it as it grows, and pupating within it. The female moth is wingless and never leaves the case, but lays her eggs inside it; while the male moth is winged, often has considerable power of flight, and fertilizes the female as she lies within the case.

The eggs being deposited inside the case, old and apparently dead cases, are just the ones which it is most necessary to destroy, for it is from these that the young insects start.

In the Museum collection is a specimen of the Noctues moth *Achæa melicerte* bred by Mr. Wood-Mason in September 1887 from a caterpillar said to attack castor-oil plants in the neighbourhood of Calcutta. The range of this insect is a wide one; it has been recorded² from all parts of India, besides Celebes and Australia. Nothing seems to be known of it as a pest.

Specimens of a caterpillar which feeds on teak leaves have been received from Dr. Tomes, of Midnapore, who writes on 26th July:—

Teak caterpillar.

“The teak trees in this station are suffering from the ravages of a caterpillar to an extent I have never known before. It is a leaf-roller,³ with the habit of suspending itself by threads; whole rows of trees have been defoliated by it in a remarkable way, the adjoining trees of other sorts escaping. The insect is now mostly in the pupa stage.”

On 7th August he writes—

“They swarmed for a short time; the old eaten-up leaves with pupæ, however, have now fallen off and a fresh crop has come out, and has not been attacked. I am unable to find a single chrysalis. No preventive measures were adopted, the plague ceased spontaneously.”

Dr. Tomes sent specimens of the caterpillar and chrysalis, which somewhat resembled those of the cotton worm *Alelia argillacea* of America; but in the present state of knowledge concerning Indian moths it is practically impossible to name Noctues with certainty, except

¹ Determined by Mr. Moore (*vide* letter from Dr. Günther, dated 17th November 1883).

² See “Catalogue of the Moths of India,” Cotes and Swinhoe, p. 402.

³ From the specimens received it appears that the pupa is formed on the tree and enveloped in the leaf.

from specimens of the moths. An attempt was made in the Museum to rear the two chrysalids of the pest which were received; no moths, however, were obtained, but from one of the chrysalids emerged a chalcid fly of the species *Chalcis* (*Brachymeria*) *euplœa*, which has also been bred from the Dooars tea pest *Dasychira thwaitesii* (see page 32). Parasites of this kind are probably partly responsible for the disappearance of the pest, and Dr. Tomes is of opinion that the birds discovered and devoured those that were not destroyed by the parasites.

It is hoped that fuller particulars may be obtained when this pest next makes its appearance.

Information¹ has been received from Mr. J. Blackwood, of injury to white rice, shipped both from Calcutta and London, while lying in Kingston, Jamaica. The injury is due to a grain moth, which from the description appears to be *Tinea granella* (or the "Wolf Moth").

One Jamaica firm writes that up to 1882 rice could be held for as long as twelve months without injury, but that, lately, rice shipped from Calcutta has been found affected a fortnight after receipt; and one shipment from London, three weeks after it was landed, had to be sold far below its original market-value; part of it indeed being actually thrown away. The firm writes—

"A small moth, like the moth that attacks furniture at home, seems to be the enemy; the rice becomes filled with millions of small worms that collect hundreds of grains around them enfolded in a web which is inseparable, and the grains are then eaten through to a shell. Yellow rice does not appear to suffer so quickly, but, as we expect shortly 1,500 to 1,700 bags, it is a serious question. We have not now a bag on our wharf, and at considerable expense we have had every store on our premises cleaned, whitewashed and disinfected with carbolic acid, and will stow every bag in sprinkled salt in the hope of curing the evil which threatens the extinction of our trade. We ascribe this visitation to low stores, which since the fire of 1882 are now by law all covered with iron, and not being sufficiently ventilated, generate too much heat. Our losses have been heavy, but the worst effect is that we fear to hold any stocks, without which the trade would virtually have to be abandoned."

The conditions which control the increase of this pest do not seem to be completely understood, the insect occurring all over the world but only occasionally doing serious injury. Reports have not reached the Museum of injury by it in India, but there is evidence to show that it already exists here, and so at any time may become destructive.

Curtis in his work "Farm Insects," p. 315 (Edinburgh 1860), gives an excellent account of this pest. He notices that when the larvæ have become full-fed in the heaps of grain, they hide themselves away in cracks and crannies, sometimes burrowing for a considerable distance into hard wood, in order to secure shelter during their chrysalis

¹ Dated Calcutta, 20th June 1888.

stage. In cleaning out the granaries, therefore, it would seem desirable to take special care to whitewash all old wood-work with hot lime, so as to fill up the crannies and burrows where the larvæ have taken refuge. Curtis notices a number of other recommendations that have been made for dealing with the pest, one of them being to sprinkle the grain with salt, as is being done in Jamaica; but the most promising measure with the Wolf Moth, as with the Wheat Weevil,¹ seems to be the thorough cleaning up of the granaries.

Obscure lepidopterous larvæ, which it is quite impossible to determine precisely without examination of the moth, have been received through the Director of Land Records and Agriculture, Bengal, forwarded by the Commissioner of Chittagong from Mr. Cosserat, who writes that they are known locally as *Sirmayee poka* or *Sirmayeilock*, and that they are said to cause "considerable damage to ripe paddy crops by separating the bunches from their sheaves." They are reported to have been particularly numerous in Baraghope and Koiarbil, in places where the rice escaped damage by salt water.

From this description it is probable that the insects belong to the group of "cut worms" (Noctues,—see p. 33), but specimens of the moth should be sent for precise determination.

Specimens of a second pest, known locally as *Silain poka*, were received together with the above from Mr. Cosserat, they are said to injure rice in the same way, and probably belong to the same group, but the species cannot be determined from the imperfect specimens received.

Caterpillar of a Noctuid moth, too obscure for identification without having the perfect insect, have been received through the Director of Land Records and Agriculture, Bengal, to whom they were forwarded by the Collector of Balasore from Koylash Chandra Rai, who writes:² that they are known locally as *Katree poka*, and that they destroy yong paddy plants, mostly in seed beds, by cutting off the plants as if with scissors just above the water. Specimens of the moth and further particulars are desired.

Specimens of an insect were forwarded to the Museum by the Director of Land Records and Agriculture, Bengal, from Babu Kali Narayan Roy, Manager of the

¹ It appears that the "Wolf Moth" is not so exclusively confined to granaries, throughout the whole of its life as is the Wheat Weevil, though it passes the greater part of its existence there.

² Letter dated Dehurda, 26th August 1888.

Chanchal Estate, Maldah, who reports that they are destructive to the jute crops.

The insect in question is probably *Spilarcia suffusa*, which is figured by Moore in his Catalogue, Lep. Mus. E. I. C., pl. xvi, fig. 10. This insect is a moth belonging to the family Arctiidæ, which feed almost exclusively on the leaves of plants, some of them being very destructive. They generally form their cocoons of hair and silk on the leaves or stalk of the plant they attack, the perfect insect being a small brownish moth.

With regard to remedies which are likely to be practicable, no information has been received. Hand-picking, or spraying with an insecticide would no doubt destroy a great many of the caterpillars, but it is very doubtful to what extent it would pay to adopt either of those measures.

Fuller particulars concerning the pest, and also live specimens, especially of the pupa (chrysalis or cocoon), are desired to form a record for future reference.

Some imperfect specimens of what appears to be the Arctiid moth *Aloa lactinea*, Cramer, were received on 8th October 1888 from the Commissioner of Settlements and Agriculture, Central Provinces, with the information that it is an injurious insect known in the Sambalpur district as the *bhalu pok*. This is a well-known insect, though little has been recorded of its life history; it is one of that large group of Bombycid moths whose larvæ feed on the leaves of plants. It is hoped to publish fuller particulars of it hereafter.

Caterpillars of two species of Bombycid moths which cannot be precisely determined in the absence of the perfect insect, have been forwarded by the Director, Land Records and Agriculture, Bengal, from the Agricultural Officer of Ranchi, who notices that they attack *gora dhan* (upland rice), one of them being also found on *Maruá* (*Elusine carocana*). He writes ¹:—

“ I have examined many fields of *Gorá* and *Maruá*, not one of which was exempt from the ravages of these pests. I cannot form an estimate of the damage caused by these caterpillars; but the fact that they are seen on every fourth or fifth blade of *Gorá* and *Maruá* (which, by the way, are the two principal upland crops of this province) shows that the damage caused by them must be more than appreciable.”

Specimens of a caterpillar that injures brinjal by boring into the stems, and which is either identical with, or nearly allied to, the Sugarcane borer, *Diatraea saccha-*

¹ In a report to the Director, Land Records and Agriculture, Bengal, dated 5th September 1888.

ralis, Fabr. (*vide* p. 22) have been forwarded by the Director of Land Records and Agriculture, Bengal, from the Agricultural Officer of Ranchi, who writes¹:—

“Regarding the little grub found inside the fleshy stem of brinjal shoots, on examining the shoots, a minute aperture will be found which is nothing else than the puncture which the female insect must have made with the ovipositor while laying her egg. On breaking the shoot just at this puncture, a small whitish grub will be found. ... This pest has done a very considerable amount of damage to the brinjal crop in all the gardens that I have had the opportunity of examining in this town.”

In one place he notices that all the plants had been killed by it; in another ten per cent. of the plants had already died off, and most of those that remained were still suffering from it, early sown plants being more severely attacked than the late sown ones. Tobacco-water was tried in one garden without effect.

Caterpillars have been received through the Collector of Balasore, forwarded by the Director of Land Records and Agriculture, Bengal, from Dehurda,² where they are reported to injure the fibre plant called *Chan*. The insect enters the *dhooly*, or fruit of the plant, and eats up the seed, and sometimes also the leaves and the upper part of the plant itself. No remedy is known, but heavy showers of rain are said to check the evil.

These are larvæ of a Noctuid moth; specimens of the moth should be sent for precise identification.

Caterpillars of a Noctuid moth have been received through the Director of Land Records and Agriculture, Bengal, from the Deputy Collector in charge, Tipperah, who writes³ that they are known as *Leda poka* and are very injurious to crops. Specimens of the moth should be sent to enable the insect to be precisely determined.

A single immature caterpillar of a boring moth, injurious to tea bushes, has been received from the late Mr. Otto Möller, of Darjeeling, who wrote (8th March 1888):—

Tea borer. “It can hardly be termed a pest, as it occurs rather sparingly. The stems, however, when attacked, are doomed to destruction. As far as I can make out, it is found right from the Terai up to the highest elevation to which tea is grown here in the hills.”

It is quite impossible to determine this insect precisely from the specimen received, but it is probably one of the Hepialidæ, a group of

¹ In a report dated 5th September, addressed to the Director, Land Records and Agriculture, Bengal.

² Obtained by Baboo Koylash Chandra Rai.

³ In a letter dated 29th September 1888.

moths well-known, all over the world, as containing numerous wood boring species. The caterpillar can no doubt be easily killed by injecting a little kerosene into the hole which it makes in the tea stem, or even by plugging up the hole with a wooden peg; it is very questionable, however, whether it will be found worth while to adopt any such measures. Live chysalids of the insect might be sent to the Museum to be reared and determined; they will, no doubt, be found in the burrow near its opening.

In the Museum collection is a specimen of a small moth ticketed as
 Sugarcane moth. injurious to sugarcane, and identified by Mr. Moore
 as belonging to a species described by Walker in
 his Catalogue, Lep. Het. B. M., pt. XVI, p. 200, as *Dragana pansalis*.
 No further information has been obtained about it.

In the Museum collection is a specimen of a Microlepidopterous insect,
 A Museum pest. which was identified by Mr. Moore in 1879 as
 belonging to the species *Tinea lucidella* (Walker,
 Cat. Lep. Het. B. M., pt. 28, p. 474). Attached to the insect is a ticket
 marked "The larva is very destructive to the horns of hollow-horned
 ruminants." No further information has been obtained concerning it.

From the Central Museum, Madras, were received (25th October 1888)
 Horra caterpillar. some caterpillars of a Noctuid moth, for the pre-
 cise determination of which the imago is required.
 The caterpillars were reported ¹ by the Collector of Kurnool to have
 appeared in a village in his district, and destroyed Horra (Indian Millet).

Coleoptera.

In May 1884 some specimens of a beetle were sent to the Mu-
 Opium and cheroot seum by Dr. L. A. Waddell, of Calcutta, with
 beetle. the information that they infested the leaf
 covering of opium balls; in August 1887 specimens were received from
 Surgeon P. A. Weir, Opium Factory, Ghazipur, North-Western Prov-
 inces; and in March 1888 specimens were received from Mr. J. Black-
 wood, who found them in rice in Calcutta.

The insect was identified as *Lasioderma testaceum*, by Mr. C. Water-
 house of the British Museum, who noticed that the insect is almost
 cosmopolitan and well-known for attacking various vegetable substances.

In his report on the Ghazipur insect, Mr. Wood-Mason noticed that
 the same beetle is frequently found in Manilla and Indian cheroots.

¹ Letter No. 3149, dated 12th October 1888, forwarded by the Superintendent, Gov-
 ernment Museum, Madras.

The writer learns from Mr. R. Chapman that in England the sale of Indian cheroots (especially Trichinopoly cheroots) is seriously interfered with on account of a boring insect, which is probably this species.

Specimens have been forwarded by Mr. H. S. Beadon, C.S., from Curculionid pests in Mr. Beck, of two species of Curculionid beetles Darbhunga. which have proved injurious in the Raj gardens, Darbhunga. Of one of these insects Mr. Beck writes that it appeared in May, when it was found eating away the stems of this season's growth, thereby causing the young shoots to wither and die, and in some cases killing the plant outright. He notices that since the rains the plants have been more vigorous in growth, and have resisted the attack of the insect better than they did in the early part of the season. This insect has been determined as *Desmidophorus hebes* of Fabricius; it appears to be fairly common in India, but has not been previously reported as a pest.

Mr. Beck writes that the other pest attacked the leaves of the "Some" plant in the same gardens. This insect is probably *Astycus lateralis*¹ of Fabricius, and has previously been sent to the Museum as destructive to the leaves of mulberry in Rangoon.

No particulars as to their life histories have yet been obtained for either of the species.

Specimens have been received from the Director of Land Records and Agriculture, Bengal, of an insect said to be injurious to brinjal plants. Baboo Kailash Chandra Rai, of Dehurda (Balasore), reports—

"It has no special name. It appears generally in the rainy season and damages young plants, and disappears when cold weather sets in. Incense is burnt in the brinjal fields with a belief that its smoke prevents the pest, but it cannot be said that it is a sure and certain remedy of the same!"

The specimens received appear to belong to the species *Epilachna vigintioctopunctata* of Fabricius, which has been recorded² as occurring in India, Java, China, Sumatra, New Guinea, Japan and Australia. This is a beetle belonging to the group Coccinellidæ, almost all the

¹ There is some doubt about the precise determination of this species.

² Vide Gemminger and Harold's "Catalogus Coleopterorum," Vol. XII, p. 3815, where the following synonymy and references are given,—

vigintioctopunctata, Fabr., Syst. Ent. 1775, p. 84.

Herbst. Käf. V, p. 264, t. 55, f. 3.

Muls. spec., p. 834.

Montrouz. Ann. Soc. Agr. Lyon. VII, 1855, p. 75.

Var. *egens*, Muls. spec., p. 836, *implicata*, Muls., l. c., p. 837; *lacertosa*, Muls., l. c., p. 838; *multipunctata*, Muls., l. c., p. 836; *recta*, Muls., l. c., p. 836; *sparsa*, Herbst. Füessl Arch. VII, 1786, p. 160, t. 43, fig. 11; *pubescens*, Hope, Gray, Zool. Misc. 1831, p. 31; *24-maculata*, Fabr. Ent. Syst. I, 1, p. 281; *28-maculata*, Motsch. Etud. Ent. 1857, p. 40.

species of which are carnivorous in their habits, many of them feeding on aphids (plant lice), and being on this account most useful to agriculture, though the group also contains some species that feed on leaves.¹ It would be desirable, therefore, to observe this insect carefully in order to ascertain that it is really a pest, before taking measures to exterminate it.

Specimens of a cockchafer (*Melolonthini*), received from Dr. George King, are to be found in the Museum collection.

Cockchafers.

Dr. Anderson wrote of them² that they have proved most destructive to the public gardens in Darjeeling, and threatened to extend their ravages.

The following extract is from a report by Mr. Jeffrey, forwarded by Dr. George King, from the Darjeeling Gardens:—

“They appear to form a cell in the soil, and when taken from it do not appear to thrive. I made up the figures yesterday of what numbers were destroyed, and I found, from nearly a month’s work, they amount to 2,695,000, so that I have rid the world of a goodly number.”

Dr. Günther, of the British Museum, to whom specimens of the insect were submitted, wrote³:—

“The beetle is most likely *Lachnosterna impressa* (Burmister. Handb., IV, 2, p. 314, Assam): but the genus is a most difficult assemblage of very numerous and closely allied species. Another species (*L. pinguis*, Walker) is mentioned as destructive to coffee trees by Haldane in his pamphlet ‘All about grub,’ Colombo, 1881.”

Specimens of the larvæ, either of this species or of an insect very closely related to it, were received in July 1881 from Mr. L. R. Forbes, of Chittagong, with the information that it attacks the roots of paddy, *kachoo*, and Indian-corn, emerging from the ground in July and August. Paddy, which is covered with water in July and August, is said to be unaffected.

Some slight damage has been done during the past year, to deal-wood boxes lying in the godowns of the Museum, by the larvæ of the Cerambycid beetle⁴ *Stromatium barbatum* of Fabricius; imago emerged in March. The life history of this insect does not seem to have been yet observed in India.

Specimens of the beetle *Cicindela 6-punctata*, Fabricius, have been forwarded by the Collector of the 24-Pergunnahs, from the Sub-divisional Officer of Diamond Harbour,

Cicindela 6-punctata.

¹ *Vide* Westwood’s “Modern Classification of Insects,” Vol. I, p. 397.

² Letter dated 22nd May 1883.

³ 17th November 1883.

⁴ See Gemminger and Harold’s “Catalogus Coleopterorum,” p. 2810.

with the information that they are known as “*sansi* insects, and are said to cut the stems of plants.” This beetle, however, belongs to a family of exclusively carnivorous insects, and it is therefore very improbable that it can have occasioned injury to plants. This insect is often found in large numbers in rice-fields, especially near the sea-shore. The injury referred to has probably been done by a species of Cut worm (Noctues).

Specimens of three species of Cerambycid beetles, injurious to trees, have been received from the Director of the Forest School, Dehra Dun :—

Cerambycidæ.

No. 1—has been found in sâl (*Shorea robusta*) in Oudh, and in saj or sain (*Terminalia tomentosa*) in Dehra. This insect is probably *Neocerambyx holosericeus*, Fabr.

No. 2—has been found in sâl (*Shorea robusta*), and jinghan (*Odina wodier*), in Dehra Dun. This insect forms a calcareous egg-like case, in which it pupates. It is, no doubt, the insect described by Mr. R. Thompson in his Report on insects injurious to woods and forests (1867), p. 415, pl. VIII, figs. 1 and 2 : it has been determined as *Plocederus pedestris* of White.

No. 3—A girder longicorn beetle, of which a practical account is being published in the “*Indian Forester*.”¹ It is probably *Calosterna scabrata*, Fabr.

A block of sâl wood from Dehra Dun has also been received, which is simply riddled with burrows of cerambycid larvæ (probably those of No. 1). The borers appear to have first lived on the sap wood, afterwards burrowing into the very heart.

It is hoped to give a more complete account of these insects hereafter.

From the Central Museum, Madras, were received some specimens of a beetle, *Cantharis* sp.? which were reported² by the Collector of Kurnool to have eaten up the leaves of yellow cholum (millet), and thus destroyed the crop in one village in his district.

Cholum pest.

From Mr. W. N. Duncan, of Calcutta, were received (21st June 1888), Biscuit beetles. specimens of beetles which injure ship's-biscuits.

These insects were sent to Dr. Günther, of the British Museum, who kindly promised to have them examined. He reports upon them as follows:—“All common warehouse insects, *Silvanus surinamensis*, *Rhizopertha pusilla*, and *Tribolium ferrugineum*.

¹ *Indian Forester*, November 1888.

² *Vide* letter forwarded by the Superintendent, Government Museum, Madras, dated 12th October 1888.

A single specimen of a scolytid beetle was received from Captain Bingham, of Rangoon, who had found about an acre of rice, situated near the sea, completely destroyed by it. Captain Bingham found that the insect bored into the stalks; he promises further particulars.

Rice scolytid.

From Mr. B. L. Frizoni, of Hazaribagh, were received some large Bostrychid (Apatid) beetles. Several of these insects were found (April 1888) alive in the interior of the stem of a young guava tree which they had killed. They were sent to Europe for precise determination.¹ Part of the stem of a coffee bush was also received, which had been destroyed by the larvæ of a boring beetle, which is probably *Xylotrechus quadripes*, Chev., the "Coffee-borer" of South India. Dr. Bidie described this pest in a report published by the Government of Madras in 1869; he found that shade and good cultivation were the best preventives.

Boring beetles.

Larvæ of a Dermestes beetle were observed by the writer, in March 1888, in vast numbers in wheat godowns in the Kapra. Delhi market, where they shelter themselves under the plaster on the walls. The owners of the godowns averred that this pest, which they called *kapra*, sometimes destroys as much as six or seven per cent. of the wheat, which is stored in a godown. The larvæ were reared in the Museum, and specimens of the beetle sent to Dr. Günther, of the British Museum, who kindly promised to have them examined. He reports on them as Dermestidæ apparently belonging to a species of *Trogoderma* not previously represented in the British Museum collections.

Orthoptera.

Specimens of an insect have been forwarded to the Museum by Baboo A. Lall Chatterjee, of Pusa, Darbhunga, who notices that it is known in that neighbourhood as *Bherwa*, and that it lives in holes about half an inch in diameter, which it constructs in the ground. He reports that it cuts the roots of the young plants of the *mokai*, tobacco, *morwa*, and other crops growing on high lands, and also injures the leaves of tobacco and cauliflower.

Schizodactylus monstrosus.

¹ These insects were sent to Dr. Günther, of the British Museum, who kindly promised to have them examined. He has since reported on them as belonging to four species of Bostrychidæ, viz., *Sinoxylon* (species new to the British Museum collection), two species of *Bostrychus*, which are not named in the British Museum collection, and *Cænophrada anobioides*, Waterhouse (Ann. Mag. Nat. Hist., 1888).

This is an orthopterous insect, determined as *Schizodactylus monstrosus*; it is hoped that further particulars may be obtained concerning it.

Specimens of an insect which resembles the migratory locust, *Acridium peregrinum* of Western India, have been forwarded by the Officiating Collector of the 24-Pergunnahs, from Raja Durga Churn Law, who notices that the insect is most destructive in Nuddea, Hooghly, the 24-Pergunnahs and Midnapore, coming in swarms, which darken the horizon and destroy whole fields. No information has hitherto been received of the presence of true locusts in Eastern Bengal, and until these specimens shall have been compared with types of the Western locust, the writer is inclined to look on them as probably distinct from it. The matter, however, is one of considerable interest, on which it is to be hoped further light will be shown.

The Indian Museum does not, at present, possess authentic specimens of the insects, which are known in India as "Locusts," and which from time to time do such serious injury to vegetation in the Punjab, and in Western and Southern India; information¹ also has been received from Surgeon-General Edward Balfour, in London, that the British Museum is similarly situated.

It is very desirable that this pest should be fully investigated, the writer therefore would suggest that authentic specimens from different localities should be obtained and sent to the Indian Museum, where some of them can be preserved for reference, and others forwarded to the British Museum, and European specialists, for examination. To secure authenticity the specimens should, in each case, be taken from some destructive swarm, as there are a large number of other grasshoppers in India, which very closely resemble true locusts in appearance, and are therefore liable to be mistaken for locusts, though they do not "migrate," or occur in sufficient numbers to occasion serious injury.

The first point which has to be settled about locusts in India is whether the destructive flights which periodically appear in the Bombay, Punjab, and Madras Presidencies, are invariably *Acridium peregrinum*, the species described by Dr. Macdonald as the locust which proved injurious in the Bombay Presidency in 1883, and which has so often invaded large areas in Northern Africa and South-Western Asia.

Winged locusts, besides the wingless larval forms and eggs, can readily be killed and preserved by dropping them alive into bottles of alcohol, which should be carefully filled up and closely corked to prevent damage by jarring on the road.

¹ A letter to the Secretary, Revenue Board, Calcutta, dated 22nd November 1888.

A summary of what has been recorded about locusts in India is being prepared and will appear in an early number of these "Notes."

Neuroptera.

White ants.

The Commissioner of Chota Nagpore (Mr. C. Stevens), writes ¹ :—

"*White ants.*—These are, according to Mr. Driver, a Tea Planter, the only insects which do any harm to the tea cultivation in Loharduggah, but these he gets rid of by constant deep-hoeing. They do not confine their attacks to tea, but most plants are more or less liable to be damaged by them, though the Manager of the Chota Nagpore Raj doubts whether they can attack healthy growing plants. Sugarcane in the Giridhi Sub-division, says the officer in charge of it, is especially liable to the attack of this insect. The Manager of the Chota Nagpore Raj says that its mode of attack is to eat up the root of live crops and cause the plants to die. The ryots, he says, are not acquainted with any remedy for it."

The Personal Assistant to the Director of Land Records and Agriculture, North-Western Provinces, notices,² that until the sugarcane borer (*Diatraea saccharalis*, Fabr.) appeared near Cawnpore, white ants had been found to be the most serious pest with which sugarcane had to contend, though they could always be more or less effectively checked by heavy watering.

Several queen white ants in various stages of development, and also a complete nest, have been received³ from Mr. J. Cleghorn, Balasore. White ants seem to be particularly plentiful in Balasore, and Mr. Cleghorn has already observed one interesting fact regarding them, namely, that the royal cell is often occupied by several queens in various stages of development, there being in some cases two or three fully-developed queens, with their sausage-like bodies laid side by side; in others a single fully-developed queen,⁴ together with an active young queen, which has evidently but recently lost its wings.

A summary of what has been recorded about white ants in India is being prepared, and will appear in an early number of these "Notes."

Diptera.

Specimens in all stages of development of a parasite of the Bengal Silkworm Fly (*Thrycolyga bombycis*, Louis), have been received from Mr. C. Marshall, of Berhampore, who writes ⁵—

"The eggs of the midge were deposited on the grub of the silkworm fly, within a few hours of the grub's cutting out of the silkworm cocoon it destroyed."

¹ In a report, dated 26th October, forwarded by the Director of Land Records and Agriculture, Bengal.

² In a report dated 30th April.

³ Through Mr. R. Blechynden, of the Agri-Horticultural Society of India.

⁴ It has been usually supposed that but a single queen is to be found in each nest.

⁵ In a letter dated 11th September 1888.

The "midge" proves to be itself a dipterous insect; it could not however be identified precisely in the Museum, and will therefore be sent to Europe for comparison.

A good deal of information has been collected about the silkworm fly which it is hoped will form the subject of a future paper.

Specimens of a pest known locally as *Lahikeeda* or *Bhuakeeda* have been received through the Director of Land Records and Agriculture, Bengal, from the Deputy Commissioner of Hazaribagh, with the information that it attacks *urid*, *barae* and *sino*, when they are almost ready for being harvested, and destroys them completely.

Amongst the leaves and stems forwarded in alcohol, were found a few pupæ of a dipterous insect. This material, however, is quite insufficient to determine the species, or even to ascertain whether this dipterous insect is the real cause of the mischief. Live specimens of this pest should be sent, so that they can be reared in the Museum.

Miscellaneous pests.

The following is from a Report dated September 1888 from the Collector of Ganjam, which was forwarded to the Museum by the Revenue and Agricultural Department of India, together with specimens Nos. 1 to 7:—¹

"1. *Pesalu purugu*.—Reported to infest green gram (*Pesalu*). This is a beetle belonging to the genus *Bruchus*. It is hoped to determine it more precisely when the specimens are returned that have been sent to Europe for comparison.

"2. *Kunkudiya purugu*.—Reported to destroy cotton, red gram, and cucumber; comprises two species of insects, namely, a chrysomelid beetle, *Aulacophora abdominalis* of Hope, which is probably the insect which does the damage; also a coccinellid beetle, *Palæopeda sexmaculata*, which is probably predacious in its habits, and therefore little likely to occasion damage to plants. Specimens of *Aulacophora abdominalis* were also received on 23rd June from the Department of Land Records and Agriculture, North-Western Provinces, where they were said to attack water caltrop (*Trapa bispinosa* = *soonghara*).

"3. *Monjikila purugu*.—Reported to destroy paddy, sugarcane and brinjal plants by eating away the pith of the stalk. This appears to be the same as the sugarcane borer moth *Diatraea saccharalis* of Fabricius, see paper on this pest, p. 22.

"4. *Nooludaran purugu*.—Reported to attack sugarcane, paddy and brinjals. This is the caterpillar of a Noctuid moth, *Achæa melicerte*.²

¹ Specimens of the moths are required for the precise determination of Nos. 5, 6, 7, 8, 9 and 10.

² See also p. 52.

"5. *Penki purugu*.—Reported to destroy country beans and other vegetables. This is the caterpillar of a Noctuid moth.

"6. *Koora purugu*.—Reported to kill vegetables. This is the caterpillar of a moth (probably one of the Pyrales).

"7. *Kandula purugu*.—Reported to feed on red gram. This is the larva of a Noctuid moth.

"8. *Gongali purugu* (caterpillars).—These insects are generally found in clusters, and damage gingelly, castor-oil, ragi, *drumstick* (?) and several other plants, as well as *Gmelina arborea* (?), beans and other vegetables; some flower plants are to some extent affected by them. In short, the caterpillar's range of damage is far wider than that of any other insect.

This was reported (20th October 1887) to be the larva of a moth belonging to the Heterocerous family *Arctiidae*, and probably to the genus *Spilosoma*.

"9. *Vanga purugu*.—This is particularly partial to brinjals, as the name imports. Was reported (20th October 1887) to be the larvæ of a pyralid moth.

"10. *Aku Telu*.—These spring up in February or March, and infest the green gram crop. Reported (20th October 1887) to be larvæ of a bombycid moth belonging to the genus *Parassa* of the family *Limacodidae*."

Some grasshoppers and caterpillars have been received¹ from the Monghyr pests. Sub-Divisional Officer of Jamui, Monghyr, who writes that they both destroy *posta* (opium plants) and rabi crops (such as grain and wheat) by devouring the leaves. He notes that the grasshopper is known locally as *Fatinga* or *Gaduhya*. This insect is the same as what has been determined in the Museum collection as *Crotogonus lugubris*, Bland.: it has also been received² from the Department of Land Records and Agriculture, North-West Provinces, as injurious to indigo. The caterpillars are Heterocerous larvæ, but are too obscure for precise identification without having the moth; they are said to be known in Jamui by the name of *Pilloo*.

From Mr. Donald Sunder, C. S., Alipore, Western Dooars, have been received specimens of mahogany wood, and Mahogany borers. also of boring grubs which have proved injurious to it. Mr. Sunder writes on 20th September—

"Two years ago I planted several mahogany seedlings in Alipore. They got on very well, and the young trees were looking very healthy. Two trees began withering

¹ Received on 2nd January 1889.

² Received 23rd June 1888.

last week and died, each after the other. As the Forest Officer of Buxar told me that his mahogany trees had failed in the Reserve Forest, I tried to find out why my trees had died, and for this purpose I cut down the dry trees and examined them. I found the bark, up to about two feet from the ground, eaten by some worm. On removing parts of the bark I found several white worms in the heart wood. These worms had eaten into the wood and had killed the trees."

On examination the borers were found to belong to two species of insects, viz. (1) a few odd larvæ of the moth *Magira robusta*, Moore, which have been noticed elsewhere (see page 35); (2) larvæ of a beetle, probably one of the Curculionidæ, but which it has not been possible to determine precisely in the absence of the perfect insect. The borers have gone very little into the hard wood, and seem to have killed the trees by making galleries close under the bark.¹

The following is a report on the insect pests, from the Collector of Nuddea, that were forwarded to the Indian Museum by the Director of Land Records and Agriculture, Bengal. — (See his letter No. 149, Agriculture, dated Calcutta, 17th January 1889.)

The specimens were found to be mostly dried up, and consequently could only be precisely determined in a few instances. Some of the pests referred to by the Collector of Nuddea, in his list dated 19th November 1888, were unrepresented by specimens; while in some cases specimens were found of which no mention had been made in the list; and in others it would appear improbable that the specimens forwarded are really the cause of the damage of which they are accused.

Kuti poka, said to attack the tender parts of the leaves, stalks, and flowers of paddy from May to July, disappearing when heavy showers fall. The box was found to contain some grains of *dhan*, with a number of specimens of a small grain moth *Tinea sp.* and a single specimen of a Hemipterous insect kindly identified by Mr. E. T. Atkinson as *Chrysopelta schlaubuschii*. The small moths are probably purely granary pests; and the Hemipterous insect is unlikely to occasion serious injury in the fields.

Dhenoforing, said to attack the tender parts of leaves, stalks, and flowers of paddy in the month of May, disappearing when the cold weather comes.

The box was found to contain fragments of an Acridid insect (Orthoptera), which was too much smashed for precise identification.

White ants, said to attack the roots, and at times the stems of young

¹ There does not seem to be any very definite remedy applicable to this kind of pest, except perhaps the radical one of cutting away and burning the parts attacked; but it seems to be pretty well established that boring insects of this kind confine their attack to trees which have had the healthy flow of the sap interfered with, either through mechanical injury, or through being in a generally unhealthy state.

plants of all sorts of crops, especially paddy, jute, and *arhar*, also all vegetables, sugarcane, and big trees; also rice in granaries, timber in buildings, and books in almirahs. They are said to disappear from the roots of crops when heavy showers fall, but never to disappear from the roots of trees.

These are white ants *Termites* (Neuroptera).

Aucha poka, said to attack the tender leaves of pulse of all kinds, linseed, *jub*, and *teel*, appearing at the time that the seed germinates, and disappearing when the plants get strong. These are Bombycid larvæ (Lepidoptera), which cannot be precisely determined from the imperfect specimens.

Sarashi or *Kalia poka*, said to attack the roots of wheat, barley, peas, *mushur*, gram, *kolai*, *moog*, linseed, *khesari*, mustard, and sugarcane, when the plants are young, disappearing when the plants grow stronger. These are obscure dried larvæ and pupæ of a Lepidopterous insect.

Hana, said to eat the seeds (*i.e.*, fruits produced and not those sown) of *mator*, *khesari*, and gram in January, when the wind blows from the south. These are indistinguishable Lepidopterous larva.

Jhenji poka, said to attack the roots of sugarcane, rice and chilly plants. There being no specified time for the appearance or disappearance of this pest, which is very scarce and does but little harm. These are two Orthopterous insects, *viz.*, *Schizodactylus monstrosus*, and a species of *Gryllus*.

Small ghora poka, said to attack *moog* in April, disappearing with the fall of rain. This is *Bruchus sp.* (Coleoptera).

Large ghora poka, said to attack wheat. This is *Mylabris pustulata* (Coleoptera).

Kapasi poka, said to destroy cotton plants. This insect has been kindly determined by Mr. E. T. Atkinson as *Lohita grandis* (Hemiptera).

Gaudi poka.—This is a Hemipterous insect kindly determined by Mr. E. T. Atkinson as *Aspongopus brunneus*.

Hena poka, said to destroy rice, gram, &c. This is the "wheat and rice weevil," *Calandra oryzae* (Coleoptera).

Shesisha poka, said to attack mustard. These are remains of obscure caterpillars with many cocoons of chalcid parasites and two pupæ of a tachinid fly.

Grasshoppers foring.—These comprise at least two species of Orthopterous insects—(a) with produced head *Atractomorpha sp.*, (b) not recognized.

Mal poka, said to destroy grain plants. This is the larva of one of the *Sphingidæ* moths.

Baga poka, said to damage plants and vegetables, comprises two

species of insects—(a) *Epilachna pubescens* of Hope (Coccinellidæ).
 (b) *Aulocophora abdominalis* of Hope (Chrysomelidæ).

Gunga fering.—This is *Atractomorpha* sp. (Orthoptera).

Footi poka.—These are small obscure Microlepidoptera, probably grain moths, *Tinea* sp.

Jale poka.—This is *Haltica cærulea*, Oliv. (Coleoptera).

Locusts, reported to attack all crops, there being no fixed time for their appearance, though it is generally said that they appear in the beginning of summer, and only disappear after eating up the entire crop. (No specimens.)

Pat poka, said to attack the tender leaves of jute in May, disappearing when heavy showers fall. (No specimens.)

Rosha poka, said to attack the tender stalks of winter paddy, at the time when it is in the ear. They are said to disappear after a fall of rain, or with the setting-in of the cold weather. (No specimens.)

Juba poka, said to attack the flowers of mustard and tobacco, disappearing at the same time as the flowers. (No specimens.)

Majura, said to attack the leaves of sugarcane in May, June, July, and August, disappearing when the canes are stripped of their leaves. (No specimens.)

Nala poka, said to attack the seeds of gram and til. (No specimens.)

Hatia poka, said to attack the inside of paddy stems in September and October. The insect resembling a white thread, and being supposed to germinate inside the plants. It is said to disappear if there is rain in October, but to destroy the plants altogether if no rain falls. (No specimens.)

Khara poka, said to attack the tender plants of jute in June or July, and pulses of all kinds in November. It disappears from the jute when heavy rain falls, and from the pulses with the setting-in of winter. (No specimens.)

Tanta poka, said to attack seed stored in granaries. (No specimens.)

Sara poka, said to attack stored rice. (No specimens.)

Undetermined Pests.

Some specimens of a pest were received on 26th September, through the Collector of the 24-Pergunnahs from Baboo

A paddy pest.

Kally Coomar Roy Chowdhari, who reported that they were at that time destroying what remained of the paddy crop in fields which had been ruined by excessive rain, and which the cultivators had therefore neglected, paddy still standing in water being untouched. The specimens arrived in such a bad state of preservation that nothing could be made out of them; fresh specimens should therefore be sent.

Some dried rice stalks, damaged by an insect described by the Collector of Bankura as the *Tota poka* were received in the begining of October, with the information that the insect had begun to attack the *amun* rice plants, but had not, up to that time (1st October), done much mischief. Fresh specimens should be sent, as it has not been found possible to make anything out of the dried stalks received.

15.—EXTRACTS FROM REPORTS.

[NOTE.—The following extracts and abstracts are taken from letters and reports which have been received without specimens. The information they contain will be of value when the insects to which they refer have been determined; for this purpose specimens should be forwarded, for without the specimens the identity of the insects cannot be definitely ascertained.]

The following is taken from a report, dated 5th November 1888, by Baboo Purno Chandra Chatterjee, Deputy Collector of Basirhat, forwarded by the Collector of the 24-Pergunnahs—

Report from Basirhat.

“*Shua poka*, a hairy caterpillar, two or three inches in length, and black or brown in colour; the hairs with which it is covered produce irritation when they get into the skin. It is very injurious to jute, sometimes entirely destroying extensive fields of this crop. It occurs in June, and is universally supposed to be due to drought, not appearing when there is the usual amount of rain. It is said that *vadri*, or early jute, which is cut in August, is more subject to attack than is *kartiki* (or late jute), which is cut in October. Very young jute plants and also old plants which have run to seed are not attacked. The pest appears suddenly, fields extending over several bighas of land being found covered with caterpillars at the very commencement of the attack. The caterpillars commence eating the plants from above downwards, devouring the leaves and bark, until they come to where the bark begins to get fibrous, when they proceed to the next plant which they treat in similar manner, and when they have thus demolished the plants in one field they proceed to the next. The caterpillars carefully select the healthiest plants for attack, leaving stunted and withered plants untouched; they also spare the mature leaves of healthy plants.

“No endeavour on the part of the cultivators can save a field which is attacked by this pest.

“The attack lasts for from seven to fifteen days; about the fourth or fifth day of the attack, vast numbers of newly hatched caterpillars of the pest may usually be found on the underside of the leaves of some of the plants; these young insects spread themselves over the field, when they are about two or three days old, and they are even more voracious than the older caterpillars.

“After the caterpillars have left a jute field, little but stalks, stripped of leaves, shoots, and bark remain, and these stalks the cultivators cut and use for fuel.

“The pest has not appeared during the past year (1888-89) in Basirhat; in 1886-87, however, a few fields were injured by it, but the damage was too slight to affect the local market, while in 1873 serious damage was done by it to the jute crop throughout the greater portion of the sub-division, very few fields escaping attack.

"*Crickets*.—Amongst minor insect pests may be noticed *uchchuingra* (or crickets), which sometimes do damage in seasons of drought. These insects burrow in the ground and uproot the seedlings or destroy them by cutting through their roots. They disappear, as soon as a heavy shower of rain falls, and are not seen again for the rest of the season. If the drought, which is generally supposed to be the sole cause of the attack, be protracted, the pest sometimes does such serious injury that the fields have to be re-ploughed and sown with fresh seeds; this, however, rarely happens.

"*Jara or twisting*.—In seasons of protracted drought the *aus* paddy, and sometimes the jute plants, are visited by a kind of blight which is known in Basirhat, as *Jara* or twisting. This blight warps and twists the leaves and shoots of the paddy and jute plants, and thus arrests natural growth. The cultivators consider it to be a 'visitation of nature' and take no steps to remove it."

In a report (dated December 1888), received through the Director of Land Records and Agriculture, Bengal, the Deputy Collector of Jungipore (Murshidabad), reports on the following insects which have at different times proved injurious:—

"1. *Korapoka*—a white insect about an inch in length that lives under ground, and destroys the roots of paddy seedlings, wheat and rabi crops.

"2. An insect which 'appears on the leaves of rabi plants, when southern winds blow in the winter season, and dies away when the western winds blow.'

"3. An insect that appears before the paddy is ripe, in *Rark* tracts, and cuts the leaves; it is also found in jute and *kalai* fields.

"4. *Gandhi poka*—which resembles a large gnat in size and appearance, sucks the juice of young paddy.

"5. *Bajarmari*—is black in colour and resembles No. 4; it appears in years of high floods and completely destroys paddy plants.

"6. *Bamani insect*—a round black insect of the size of a large pea; has similar habits to those of No. 5.

"7. *Faring fly*, with black body and red 'face,' attack paddy blades; when numerous they also destroy other plants and trees."

The following is taken from a report,¹ dated 16th November 1888, by Baboo Adhar Kali Mukerjee, to the Deputy Commissioner of Hazaribagh, forwarded by the Director of Land Records and Agriculture, Bengal:—

"A caterpillar, due to excess of rain, which attacks the roots of *mokai* when the plants are from 4 to 6 inches high.

"A small green insect, due to excess of rain, that eats the stalks and leaves of *mokai*.

"*Gonderpilna*, a pest due to excess of rain, that eats the stalks and leaves of *mokai*.

"Two species of insects, one being a kind of fly, and the other known as *Chilna*, which are due to excess of rain, and which suck the undeveloped seeds of *marwa*, leaving only the husks.

"*Balwa*, a grub that eats up the young plants of *urid*.

"A green insect, due to excess of rain, which cuts the plants of *urid* when they are 3 or 4 inches high.

¹ In this report the same insect seems, in several instances, to have been described more than once.

"Two kinds of insects known respectively as *Gandhipilna* and *Lobipilna*, which destroy the flowers and pods of *ghangra*.

"*Lalpilna*, a red insect, due to cloudy weather, which eats up the seeds of *ghangra* when they are green and soft.

"*Gondhi* plants suffer from three different kinds of insects, all of which suck up the undeveloped seeds. The three insects are (a) a kind of fly due to excess of rain; (b) and (c) insects known respectively as *Chilna* and *gondhi*, which are due to excess of rain and heat.

"*Barai* plants suffer from four different kinds of insects, all of which eat up the leaves and cut the stalk. These insects are known as (a) *Balua*, (b) *Chornopilna*, (c) *Lalupilna*, (d) *Gandui*, which is a kind of fly, supposed to be due to excess of rain and heat.

"Three different kinds of flies all of which suck the undeveloped seeds, viz. (a) *Gandhi* which damages *gora* and *kodo* crops; (b) *Chilna* which attacks *gora* and *dighio* crops, and is supposed to be due to excess of rain and heat; (c) *Makhi*, which damages the *dighio* crop and is supposed to arise in grass.

"*Kharपुरi*, a small green insect which attacks *dhan* plants, at the time of flowering, and causes them to wither.

"*Bokhi*, a white insect which eats up *dhan* plants.

"*Balna*, a red insect which eats up *kurthi* seeds, in cloudy weather, when they are green and soft.

"*Balna pilna*, a pest supposed to be due to excess of rain which destroys the green til pods.

"*Gandhi pilna*, a pest which arises in cloudy weather and destroys the flowers of *sarso*.

"*Lurka*, a green insect which eats up the grain of *boot* when it is green and soft in cloudy weather.

"*Balna*, a red insect which eats up the grain of *khasari*, when it is green and soft, in cloudy weather.

"*Kajra*, green, black and red insects which cut *pushta* plants, in cloudy weather, when they are 4 to 6 inches high.

"*White ants* known as *dewant* which are supposed to be due to dampness; they cut the roots of young *kitari* plants when less than 18 inches high.

"*Kijra*, a green insect which eats up the young plants of *gohum* and *jas* when they are about 6 inches high."

A Hazaribagh report.

The following is from a report dated 7th November 1888, from the Deputy Commissioner of Hazaribagh—

"1. *Gandhi Macchi*.—Attacks *gora* dhan and *badhian* dhan while the crop is in ear. It destroys up to twelve annas of the crop. This pest generally appears in the year in which the rains set in early, that is, in May.

"2. *Lahi keeda* and *Bhua keeda*.—Attack '*urid*,' '*baroi*,' and '*sim*,' when they are almost ready for being harvested, and destroy them completely.

"3. *Gandhi keeda* and *Bhogjogri keeda*.—Damage the leaves of *kohrah*, *ghangro*, and other creepers.

"4. *Banki keeda*.—Attacks the dhan plant, generally when it is transplanted late, and the transplantation is followed by heavy showers of rain."

The Collector of Bankoora (Mr. W. V. G. Taylor) in a report, dated Bankoora report. 25th August 1888, writes:—

"The occurrence of an insect pest in the jurisdiction of police station Khatra, in the paddy fields of villages Ambicanagar, Kapradara, Banzilla, Darsole and Huridrahan

covering an area of about 13 square miles, of which about 1 square mile has been affected by a species of insect locally called *Nali poka*, which has been eating up the leaves of young rice plants. These insects are now in their caterpillar stage.

"The Sudder Police Inspector reports that these insects would have eaten up the leaves of the plant in the course of a fortnight had there been no rain for some time. But as heavy and continuous rain has lately fallen in that part of the district, there is no longer any cause for apprehending further damage by these insects. The cultivators say that excessive rainfall in the latter half of the month of Joisto (May), followed by drought or slight rain in Asar (June) is the cause of their origin. It is supposed that the rains of Joisto (May), decomposed all dead vegetable matters from which the insects take their birth, at first in the shape of eggs, but if there are heavy showers of rain so as to wash away all putrid substances, the eggs are destroyed and caterpillars, such as are sent, appear. They do not form cocoons."

Extract from a report, dated 26th October, from the Commissioner of Chota Nagpore report. Chota Nagpore (Mr. C. C. Stevens) :—

"1. *Caterpillar*.—This is the only insect pest, which so far as the Singbhoom authorities have been yet able to ascertain, which infests agriculture in that district. It is described by them as 'small, hairy black or dark colored,' and locally known by the name of 'Lehobari.' It attacks the young *dhan* plants in seasons in which there is insufficient rainfall and when in consequence much heat and dryness prevail; it cannot stand exposure to water, and eats up the tender leaves of the *dhan* seedlings only down to the level of the water. The Manager of the Dhulbhoom Estate says that the caterpillar undergoes a series of metamorphoses similar to the tussar or silkworms. It wraps itself gradually up on the leaf it preys upon, and is there changed into a chrysalid or cocoon of a shining black color.

"2. Caterpillars are also known to the Loharduggah and Giridih ryots. The Manager of the Chota Nagpore Raj classifies them into three varieties, and the Sub-Divisional Officer of Giridih speaks of two. Those mentioned by the former are the following :—

"(a) That of a black color found in *Burwa*, known by the name of *Nandana Sella*. It chiefly prevails during the rains, though sometimes in the cold season also. It feeds on all crops and grasses, and is said to be poisonous in its bite, and if trodden on causes sores on the feet. It is of the size of the Bhowa insect. The Manager promises to send samples, if desirable.

"(b) That of a yellow color, known as '*Boosa*' caterpillar. It is much the same as variety (a): it attacks '*murwa*,' '*borai*,' and cotton plants; it does not cause sores on the feet. There is no remedy known for it.

"(c) That of a green color, about one inch long, and called '*Sarka*' caterpillar. '*Mustard*' *sorsa* and *lotui* crops are specially affected by it.

"The varieties mentioned by the Giridih authorities are —

"(a) The *Loorka pillu* which gets below the soil and attacks the young paddy and makai plants, severing them just at the junction between stem and root; sometimes attacking grain plants also, and is otherwise known by the name of '*Chirva*.'

"(b) Another, of which the local name is not given, eats away the pistil of the female flowers of the makai before the virules are fertilized, and the seed stalks grow up without a single grain.

"6. The names of the other insect pests, with their habits and remedies, if any, for their eradication, are shown below, the information being supplied by the Sub-Divisional Officer of Giridih.

"*Poonchi*—Attacks paddy seedlings before they are transplanted and destroys all the leaves.

"*Kuttra* or *Pahin* and the *Hurra pillua* (Green Worm)—Attacks the tender leaves of the dhan and makai respectively, and weaken the plants considerably.

"*Kujra*—Attacks the dhan, if there is cloudy weather just as the ears are forming, and severs them.

"*Mukhi*—Attacks the young grains of dhan and marwa, sucks up the milk and leaves only the husk.

"*Gundhi*—Impregnates the grains of murwa on which it happens to sit with the substance which emits the disagreeable odour, for which the insect is notorious, and the grains have a nasty smell and assume a shrivelled appearance.

"*Bulua*—Attacks the young grains of *kurthi*, *khesiari*, *chena*, *urid*, *masoor* and *moong*, and destroys them completely.

"*Lahee* or *Boorhia pillua*—A red fly which attacks mustard plants and vegetables such as *khisa* and *jhinga* and destroys them completely.

"*Tiddi*, or locust, is rare, but not unknown.

"The above, the Giridih officer says, are all visible, but there is a disease in dhan plants known as *Aren* or *Bhinks*; it attacks the plants when in ear and is supposed by many to be caused by a small insect inside the stalk."

The following information has been supplied by the Manager of Chota Nagpur Raj:—

"*Bauku*—Affects both planted and sown dhan (rice), particularly if sown late; rice affected turns white and dies. Insect surrounds itself with leaves and makes a pipe in which it lives. The preventive measure adopted by ryots is good—early cultivation and keeping fields moist; if they do occur in early crop, they flood it and try to drown them and beat them off the plants into water.

"Flies or (*Makkhi*)—Of different kinds said to drink the milk of corn forming. To prevent this, ryots put branches of trees in their fields to attract birds to rest and then to eat the flies.

"*Hardak* or *Gowrab*—Attack the wheat, *hardak* is said to attack it when yellow, and *gowrab* when it is red.

"*Ghangra*—Green color, $\frac{1}{2}$ inch long, found in gram and *kesari* pulse.

"*Lakee*—Small flies; occur in rains; attack 'sarso,' 'lotin,' 'rahr' and dry them up.

"*Black and red ants*—Are injurious to silk cultivation."

The Manager says that any further information, or specimens of any of these can be provided if required.

The following extract is taken from a report, dated 29th October 1888, by the Sub-Divisional Officer of Palamow, Lohurdugga, Chota Nagpore, forwarded by the Director of Land Records and Agriculture, Bengal.

A Chota Nagpore report.

The report notices that, of all the insects mentioned in the list, the locusts are the most injurious, totally destroying the crops on which they settle:—

"1. *Lahi*—A kind of black insect; does great mischief to mustard and *barai*.

"2. *Tidi*—(Locusts) are of various kinds of different size and color, the biggest are about 3 or 4 inches in length. They are rarely seen, but whenever they appear in great numbers they totally destroy the crops on which they settle. The smaller ones

are generally found here, but they do not make a wholesale destruction of any crop; the locusts generally feed on dhan, sugarcane, cotton, mangoes, &c.

"3. *Chatter*—A kind of wingless insect, with a red head, but the body is grey. It materially injures the dhan and makai crop. It is generally found inside the plants.

"4. *Bhooa* (caterpillars) are of various kinds and of different colours; destroy *til*, wheat and dhan.

"5. *Khaira*—A kind of red insect; does great mischief to dhan.

"6. *Balooi*—A kind of small wingless red insect; which eats up the seeds of *rahur*, *kurthi*, *barai* and *bodi*, &c.

"7. *Gadahia*—A kind of small-winged and flat insect; eats up the roots of barley and wheat in Kartic (October), when they begin to shoot up."

"8. *Gerooi*—A kind of red insect.

"9. *Hurda*—A kind of green insect; destroys barley and wheat in Falgoon (February) and Chait (March).

"10. *Ghagra*—A kind of green insect; is found in the capsules of the gram plants in Falgoon (February), when they begin to blossom, and does material injury.

"11. *Banki*—A kind of small (white or green) creeping worm; destroys the dhan plants in Sravan (July), Bhado (August) and Asin (September) by eating away the stalk and the leaves.

"12. *Katur*—A kind of winged insect (like a grasshopper), about half an inch long; destroys the stalks of wheat and barley.

"13. *Jhasi*—A kind of small, black, wingless insect; destroys both kinds of *til* by eating away the leaves and the stalks.

"14. *Phatangi*—A kind of worm; lays eggs and dies soon after; from the eggs are born worms called *Nandua*, which creep over the ground and do great mischief to *dhan*, *marooa*, *gondli*, &c.

"15. *Karup*—A kind of small green worm; is born during the winter season and destroys the rabi crop.

"16. *Bhoodli*—A kind of big worm, with red head; destroys *bodi*, *barai*, and *urid* by eating away the leaves.

"17. *Gadhi*—A kind of green creeping fly; sucks up the juice of dhan plants.

"18. *Jhinjhoor* destroys the roots of barley and wheat plants.

"19. *Bala*—A kind of small green wingless worm; is found in the capsules of *gram*, *peas*, *khesari* and *masoori*.

"20. *Jharni*—A kind of green worm about an inch long and thin, like a thread; does much mischief to *Bhadri* crop.

"21. *Toonki*—A kind of grey worm, about half an inch long; destroys the ears of dhan.

"22. *Phinga*—A kind of worm of brown colour about quarter of an inch long; destroys the leaves of wheat and barley plants."

The following is from a report, dated Dalalbazar, 12th August 1888, by Baboo Chandra Roy, to the Collector of Noakhally report. Chhally, forwarded by the Collector of Chittagong through the Director of Land Records and Agriculture, Bengal :—

"1. *Mahooah*—Color green; winged, having trunk; injures nearly $\frac{1}{4}$ crops when the corn issuing from the stem remains like milk in its kernel stage; not available at present time, but in October when the corn is nearly matured.

"2. *Shonamukhi*—Color black; one-fourth inch in length; injures the leaves and stem of the plants in Ashar and Sraban (July and August). Almost half the crops are damaged by it.

"3. *Tutia*—Color black; $\frac{1}{8}$ th inch in length; is seen in Ashar and Sraban (July

and August); injures the leaves and stems of the plants, and thus causes destruction of whole and sometimes half of them.

"4. *Maija*—Color white; face red, no wings; $\frac{1}{2}$ inch in length; originates in field; injures the stem in Ashar and Sraban (July and August); when these insects attack any field they make damages to almost all the crops.

"5. *Sani*—Color brown; winged; length one inch; injures the bunch of corn in Agrahayan and Pous (November and December).

"6. *Arangi*—Body black; face red; breast white; $1\frac{1}{2}$ inch in length; injures the stalk and stem of the corn in Agrahayan and Pous (November and December); sometimes a quarter to three-eighths of the crop is damaged by it.

"7. *Leda*—Color whitish; face black; no wings; originates in field; injures the stalk of paddy leaves of *capsicum*, *brinjal*, *bean*, *pea*, *gourd* (*kumra*), and a stalk-like plant called (*data*), &c.

"8. *Large Gandhi*—Color black; shape round; having bad smell in its body; causes inflammation if any one touches it, injures bean, pea, cucumber, gourd (*kumra*), leaves of *brinjal*, &c.

"9. *Small Gandhi*.—Color red, spotted with black; smaller in size than the former one; damages the plants mentioned above.

"10. *Karipoka*—Color green; winged; injures cucumber, gourd, &c."

The following is an extract from a letter from Baboo Kailash Chandra Rai, of Dihurda, dated 17th August 1888, to the Collector, Balasore, forwarded by the Director of Land Records and Agriculture, Bengal—

A Balasore report.

"At present I beg leave to draw your attention to two sorts of insects. One of them is '*Mulia poka*,' or insect destroying the root. This '*Mulia poka*' is a great pest of the young paddy plants. It comes into existence when there is drought or scanty rain, and destroys most of the plants of the field. It disappears or dies when rain begins to fall copiously. But the plants injured by the pest become rotten and fall down as the rain water increases. Fields infested by the '*Mulia*' insect do not produce good crops, although resown with much care afterwards. Some people burn the straw that remains in the field after the crop is gathered, with a belief that such burning checks the pest of the '*Mulia*' insect, but it is difficult to say how far the remedy is effective. Specimens of these insects cannot be had at present, as they are all gone under water."

A Monghyr report.

The following extract is taken from a report dated 6th December 1888, forwarded by the Collector of Monghyr:—

"1. The most terrible pest of crops here is an insect called *Kajra* which eats up not only paddy, but also all the rabi crops. It is a snail-like animal, about two or three inches long, and is of a dark complexion. The similar, but smaller, species is called *Larka*, which eats up rabi crops. The *Bhua*, or caterpillar, is well known. There are three species of this insect, red, black and white, which appear whenever there are clouds and fogs in November or December, and devastate the rabi crops; but if there be any heavy shower they generally die and disappear, and the crops are saved. *Lahi*, a kind of small insect, is very injurious to rabi crops, especially to mustard. There is a Dhoosur-colored (earth-colored) insect called *Gadhya* or *Kutooa keera*, which does much harm to the *Aghany* paddy by cutting the ears of the crop. The *Babhui*, which is of the size of a large fly, devastates the paddy.

"2. These are all the important insects which are injurious to crops, and their action is substantially the same. They eat up the green of the plants, leaving the stem to wither. They are generally met with when the weather is cloudy and there is no rain, and they disappear with a heavy shower. It would be conferring a great blessing on the agricultural population and men in general if, from studies of insect life, measures can be adopted to prevent their inroads."

The following is taken from a letter, dated 26th September 1888, addressed to the Collector of the 24-Pergunnahs
 Report by Raja Durga Charan Law, C.I.E. by Raja Durga Charan Law, C.I.E.: specimens illustrative of Nos. 1 and 2 were forwarded to the Museum, but arrived in too bad condition to make anything of:—

- "1. In Midnapore a pest known as '*Jot kati*' eats up the leaves of plants.
- "2. In Nuddea Dihi a pest known as '*ancha*' destroys the leaves and stalks of jute crops.
- "3. In Khoolna a pest known as '*Pamuri*' infests the growing stalks of (rice?); its increase is favoured by cloudy weather.
- "4. A pest known as '*Katra*,' which has some resemblance to a small crab; infests paddy seedlings, sucking up the juice of the leaves.
- "5. A pest known as '*Lada*,' a grub which cuts the paddy stalks when the grain is ripe.
- "6. A pest which bores into growing paddy stalks, and is very destructive."

In a letter dated 2nd September 1888, forwarded by the Officiating Collector, 24-Pergunnahs, Baboo Koonja Lal Mookerjee, the manager to the estate of the late Raja Degumber Mitter, C.S.I., notes as destructive to paddy in Backergunge, an insect known as '*Mazra*.' He writes that the insects are "very small in size, not easily perceived by the naked eye; they grow in the joints of the paddy plants and destroy them very soon." He also notices an insect known as '*Nedú*,' which is found in the ripe paddy in October and November, and cuts off the ears of the paddy. The pest appears chiefly in cloudy weather when the rainfall is insufficient.

In a letter dated 25th August 1888, from the Magistrate of Durbhunga, a pest is noticed as injurious to the makai crop; it is said to be a sort of cricket, locally known as *Bherúá*.

In a report dated 8th October 1888, forwarded by the Director of Land Records and Agriculture, Burma, is noticed a hairy caterpillar which attacks rice and maize in July and August, sometimes destroying as much as half the crop.
 A Burma report.



a

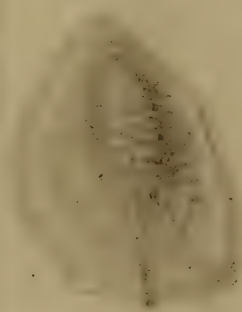


b

1 THE RICE SAPPER.
Leptocorisa acuta, THUNB.



2. *Cerataphis*, Sp.



a



b



c

3 *Lecanium acuminatum*, SIEG.



a



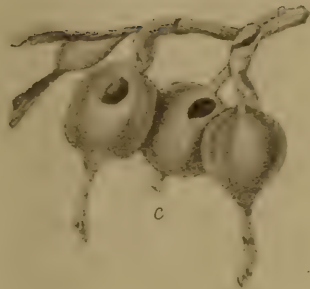
b

c

4. *Suastus fremius*, FABR.



a

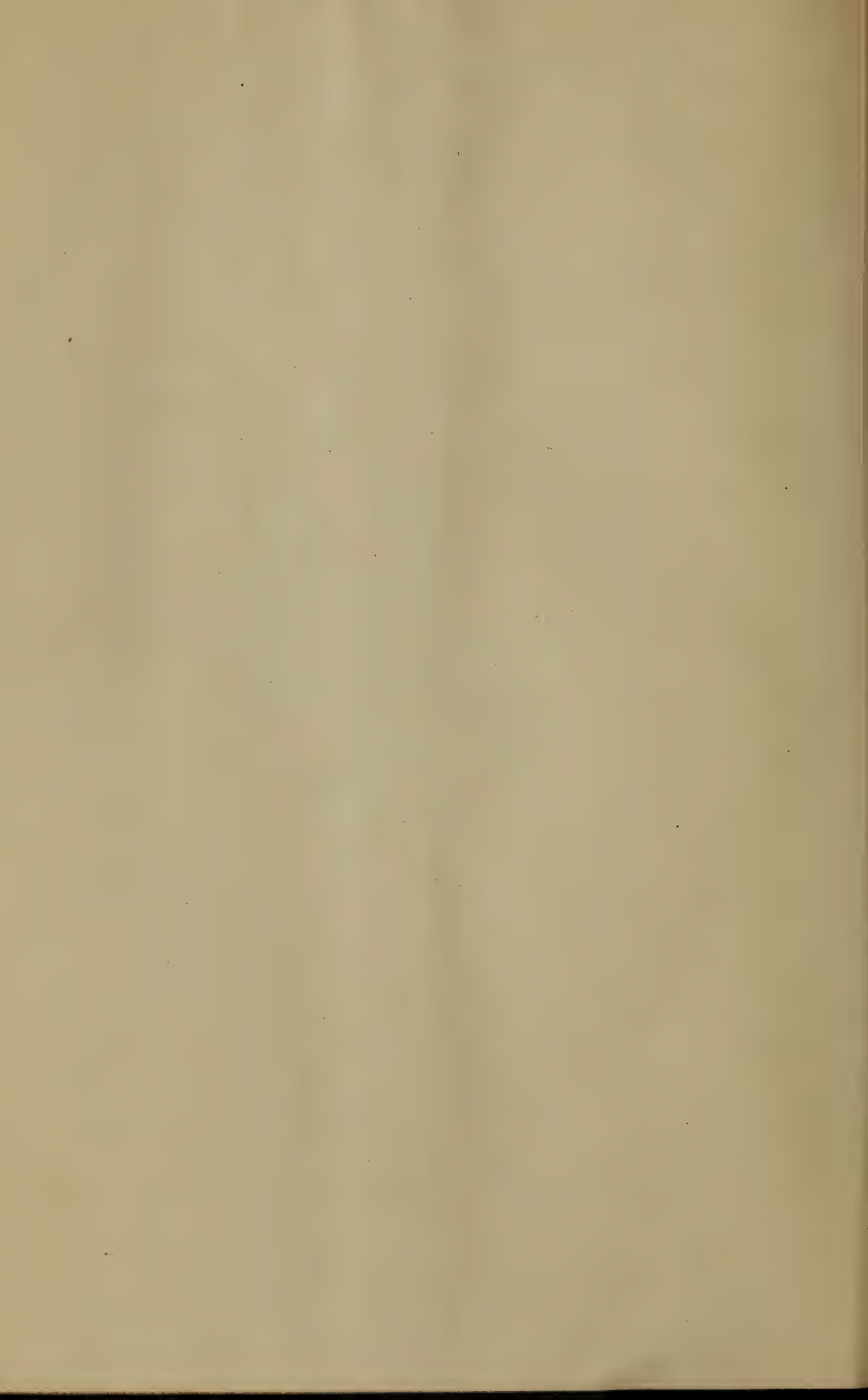


c



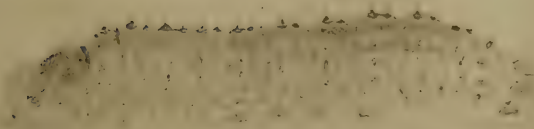
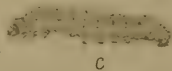
b

5. CARDAMOM PEST.
Lampides elpis, GODART.



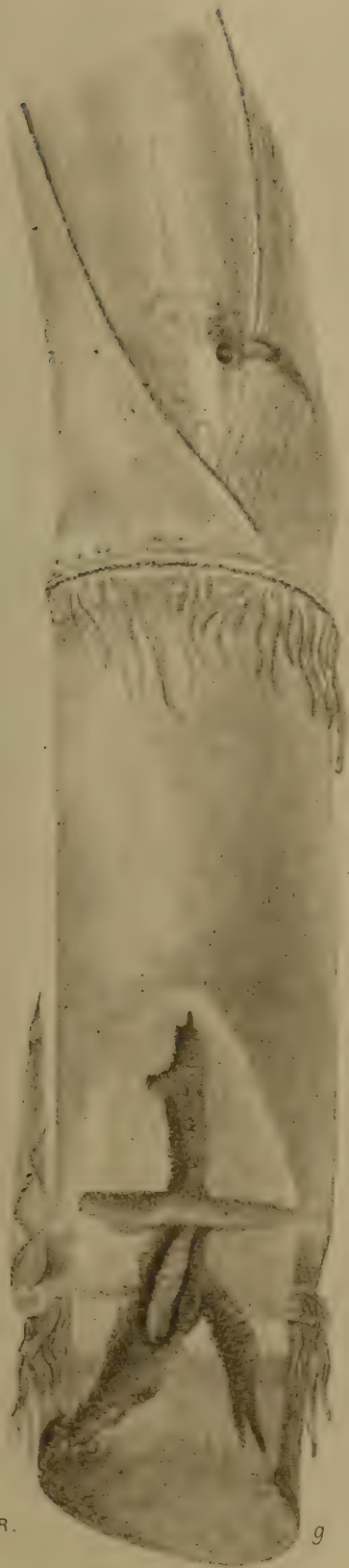


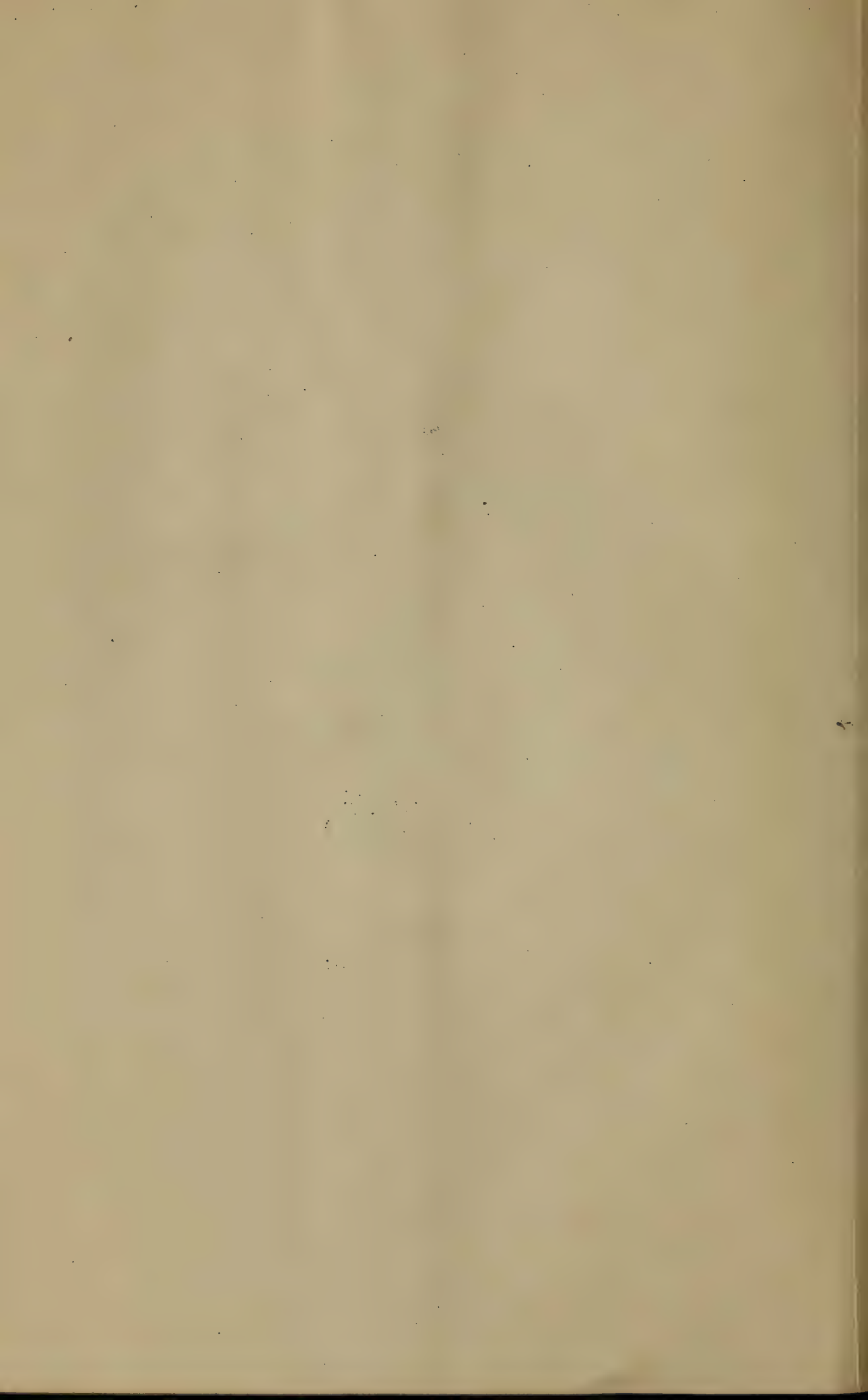
1. THE BENGAL RICE HISPA.
Hispa aenescens, Baly.



d

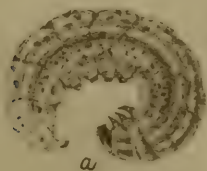
2. THE SUGAR CANE BORER.
Diatraea saccharalis, Fabr.







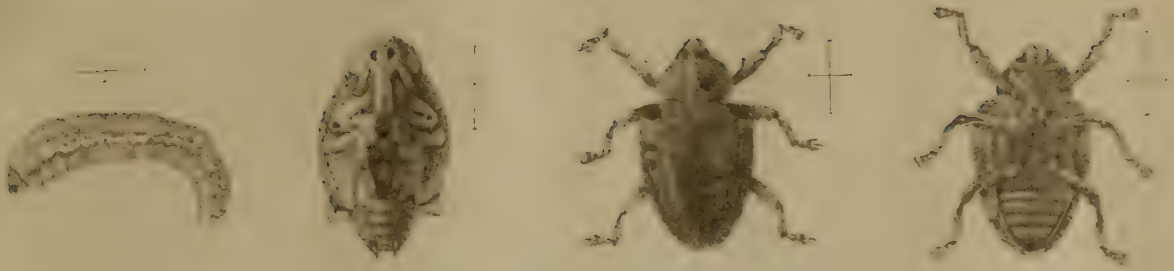
1. TEA AND SAL PEST.
Dasychira Thwaitesii, Moore.
(with parasites.)



2. CUT WORM.
Agrotis suffusa, Hübn.



3. CEDRELA PEST
Magira robusta, Moore.



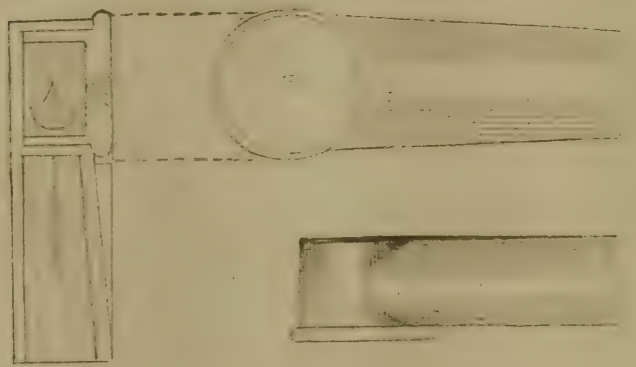
1. THE MANGO WEEVIL.
Cryptorhynchus mangiferae, Fabr.



2. *Dermestes vulpinus*, Fabr.



3. FORCE PUMP.



4. CYCLONE NOZZLES.

Grish Ch. Chuckra butty, del.

PLATES.

PLATE I—

1. *Leptocorisa acuta*, Thunb.

a.—(enlarged).

b.—(nat. size).

2. *Cerataphis* sp., (enlarged).

Taken from figures, by Mr. G. B. Buckton.

3. *Lecanium acuminatum*, Sign.

a.—Scale, dorsal view (enlarged).

b.—Scale, side view (enlarged).

c.—Larva (enlarged), copied from Signoret's figure in Ann. Soc. Ent. Fr. (5), III, (1873).

4. *Suastus gremius*, Fabr.

a.—Imago.

b.—Larva.

c.—Pupa.

5. *Lampides elpis*, Godart.

a.—Imago taken from a Ceylon specimen.

b.—Larva } Taken from figures, by Mr. E. E.

c.—Cardamom fruit injured by larva } Green.

PLATE II—

1. *Hispa ænescens*, Baly.

a.—(nat. size) } Taken from Chittagong specimens.

b.—(enlarged) }

Diatræa saccharalis, Fabr.

a.—Moth (nat. size) }

b.—Larva, dorsal view (enlarged) }

c.—Larva, side view (nat. size) }

d.—Larva, side view (enlarged) }

e.—Pupa (nat. size) }

f.—Pupa (enlarged) }

g.—Piece of sugarcane (natural size) to show tunnels. Taken partly from Calcutta specimens, and partly from figure, by Revd. L. Guilding in Trans. Soc. Arts, Vol. 46, (1828).

PLATE III—

1. *Dasychira thwaitesii*, Moore.

- | | | | | | |
|-------------------------------------------------------------------|---|---|---|---|--------------------------------------------------------------|
| a.—Moth, female (nat. size) | . | . | . | . | } Taken from Doocars' specimens reared in the Indian Museum. |
| b.—Moth, male (nat. size) | . | . | . | . | |
| c.—Cocoon in tea leaf (nat. size) | . | . | . | . | |
| d.—Pupa (nat. size) | . | . | . | . | |
| e.—Larva, dorsal view (nat. size) | . | . | . | . | |
| f.—Larva, side view (nat. size) | . | . | . | . | |
| g.— <i>Chalcis euplœa</i> , Hope. Parasite (enlarged) | . | . | . | . | } |
| h.— <i>Perilampus</i> , new species, Cameron; Parasite (enlarged) | . | . | . | . | |

2. *Agrotis suffusa*, Hübn.

- | | | | | | |
|---------------------------|-------------------------------------|---|---|---|-----------------------------------------------------------------|
| a.—Larva (nat. size) | . | . | . | . | } Copied from Riley's figures in Rep. U. S. Entomologist, 1884. |
| b.—Larval head (enlarged) | . | . | . | . | |
| c.—Moth (nat. size). | Taken from a specimen from Jessore. | | | | |

3. *Magiria robusta*, Moore.

- a.—Moth (nat. size), drawn from a Ceylon specimen.
- b.—Pupa (nat. size), copied from figure in Moore's Lep. Ceylon, vol. III.
- c.—Larva (nat. size), taken from Dehra Dun specimens, the cedrela stick, from a sketch, by Mr. E. E. Green.

PLATE IV—

1. *Cryptorhynchus mangifera*, Fabr.

- | | | | | | |
|-----------------------------------|---|---|---|---|----------------------------------|
| a.—Larva (enlarged) | . | . | . | . | } Taken from Calcutta specimens. |
| b.—Pupa (enlarged) | . | . | . | . | |
| c.—Imago, dorsal view (enlarged) | . | . | . | . | |
| d.—Imago, ventral view (enlarged) | . | . | . | . | |

2. *Dermestes vulpinus*, Fabr.

- | | | | | | |
|------------------------------------------------------|---|---|---|---|---------------------------------------------------------------------|
| a.—Larva, dorsal view (enlarged) | . | . | . | . | } Copied from Riley's figures in Rep. U. S. Entomologist, for 1885. |
| b.—Larva, side view (enlarged) | . | . | . | . | |
| c.—Pupa (enlarged) | . | . | . | . | |
| d.—Imago (enlarged) | . | . | . | . | |
| e.—Imago (nat. size), taken from Rajshahye specimen. | | | | | |

3. Force pump.

Taken from figure in Hubbard's Report on orange insects, U. S. Dep. Agri. Entomology.

4. Cyclone nozzles.

- a.—Ordinary cyclone nozzle, copied from figure in Hubbard's Report, 1881.
- b.—} Vermorel modification of cyclone nozzle, copied from a wood-cut forwarded
- c.—} by Dr. Riley.

